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Redfish Catch Results from the Summer 2009, 2011 and 2014 Surveys in Unit 2

D.W. Kulka and D.B. Atkinson

Science Branch
Fisheries and Oceans Canada
PO Box 5667
St. John's, NL A1C 5X1

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Foreword

This series documents the scientific basis for the evaluation of aquatic resources and ecosystems in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

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ABSTRACT

Within redfish management Unit 2 (portions of North Atlantic Fisheries Organization (NAFO) Subdiv. 3Pn, 3Ps, 4Vn, and 4Vs), the Groundfish Enterprise Allocation Council (GEAC) has funded redfish surveys since 1997. These surveys are the only available index of Unit 2 stock condition given the Department of Fisheries and Oceans (DFO) last surveyed Unit 2 redfish in 2002. GEAC funded and performed the surveys with scientific guidance from DFO in the design and execution of stratified random surveys and associated sampling. The data collected during these surveys have been subsequently analyzed on behalf of GEAC with the additional intent of providing this information to DFO, for their databases and future assessment work. The 9th, 10th and 11th such GEAC redfish surveys in Unit 2 were completed in 2009, 2011 and 2014. Survey catch statistics, length distribution, and stratified analysis estimates of redfish abundance and biomass, and interpretation of results are presented for those years and compared to previous surveys.

In most years, largest catches were observed south in the Laurentian Channel and along the shelf edge. Only in 1998 were large catches observed in the north adjacent to Unit 1. Normally, nearly all biomass was concentrated along the shelf edge. Interannual variations in distribution suggest that the fish move around within Unit 2 but are generally more concentrated in the south. Overall, in Unit 2, the total biomass index has fluctuated without trend since the early 2000s. For 2011, biomass was 119 kt up from 110 kt in 2009 but remains below the 2001 estimate of 141 kt. The abundance index also fluctuated without trend since the early 2000s. Total abundance of 372 M in 2011 is the highest since 2001 but remains well below 1997-98 values. In 2005, a nine cm peak of fish was observed indicating the presence of much younger fish than previously observed in significant numbers, likely fish that were two year olds. That peak persisted and increased in size through 2011. This suggested the presence of a significant 2002 year class. Change in survey gear and platform in 2014 makes the numbers non-comparable to previous years. The new Campelen gear likely has a substantially different q (catchability) compared to the Engel particularly in terms of abundance at length.

Résultats des prises de sébaste tirés des relevés de l'été 2009, 2011 et 2014 dans l'unité 2

RÉSUMÉ

Dans la zone de gestion 2 (parties des sous-divisions 3Pn, 3Ps, 4Vn et 4Vs de l'Organisation des pêches de l'Atlantique Nord-Ouest) du sébaste, le Conseil des allocations aux entreprises d'exploitation du poisson de fond (GEAC) finance des relevés sur le sébaste depuis 1997. Ces relevés constituent le seul indice disponible de l'état du stock de l'unité 2, étant donné que Pêches et Océans Canada a effectué le dernier relevé sur le sébaste de l'unité 2 en 2002. Le GEAC a financé et réalisé les relevés avec l'aide de Pêches et Océans Canada, qui a fourni des conseils scientifiques pour la conception et la réalisation des relevés aléatoires stratifiés et des échantillonnages connexes. Les données ainsi recueillies ont été analysées pour le compte du GEAC, et en vue de les transmettre à Pêches et Océans Canada pour les bases de données et les futurs travaux d'évaluation. Les 9e, 10e et 11e relevés du GEAC sur le sébaste dans l'unité 2 ont été achevés en 2009, 2011 et 2014. Le document présente des statistiques sur les captures, la répartition par longueur et des estimations par analyse stratifiée de l'abondance et de la biomasse du sébaste ainsi que l'interprétation des résultats pour ces années et par rapport aux relevés précédents.

Pour la plupart des années, les prises les plus importantes ont été observées au sud du chenal Laurentien et le long du bord du plateau. Des prises importantes ont été observées dans la zone nordique située à côté de l'unité 1 en 1998 seulement. Normalement, presque toute la biomasse se trouve le long du bord du plateau. Les variations interannuelles en matière de répartition laissent supposer que les poissons se déplacent dans l'unité 2, mais ils se trouvent plus souvent au sud. Dans l'ensemble, l'indice de la biomasse totale pour l'unité 2 a fluctué sans présenter de tendance depuis le début des années 2000. En 2011, la biomasse était de 119 kt, supérieure à celle de 110 kt enregistrée en 2009, mais elle reste inférieure à l'estimation de 2001 de 141 kt. L'indice d'abondance a également fluctué sans présenter de tendance depuis le début des années 2000. L'abondance totale de 372 millions en 2011 est le niveau le plus élevé depuis 2001, mais il demeure bien en deçà des valeurs de 1997-1998. En 2005, un poisson d'une longueur record de 9 cm a été relevé, indiquant la présence de poissons beaucoup plus jeunes que ceux observés auparavant en grand nombre, soit probablement des poissons âgés de deux ans. Ce record en matière de taille est devenu une tendance et la croissance de la taille a persisté jusqu'en 2011. Cette tendance suggère la présence d'une importante classe d'âge en 2002. En raison des modifications apportées à la plateforme et aux engins de relevé en 2014, les chiffres sont incomparables à ceux des années précédentes. Les nouveaux engins Campelen sont probablement considérablement différents en matière de capturabilité (q) par rapport aux engins Engel, particulièrement sur le plan de l'abondance selon la longueur.

INTRODUCTION

Redfish comprise a complex of three species, *Sebastes mentella, S. fasciatus* (plus heterozygotes, a hybrid) and *Sebastes marinus* in Canadian Atlantic waters. All of those species/hybrids occur and intermix within redfish management Unit 2, (as well as Unit 1), a management area that encompasses NAFO Div. 3Ps, 3Pn, the Laurentian Channel portion of 4V and $4W_{fgj}$ (Fig. 1a) (McAllister and Duplisea 2012). The majority of those fish occupy the deepest parts of the Unit 2 in and around the Laurentian Channel, just outside the Gulf of St. Lawrence (McClintock and Teasdale 2007).

Redfish fishery management in the Laurentian Channel and surrounding areas has a complex history. Redfish was formerly managed as three units: Div. 4RST, Div. 3P, and Div. 4VWX (Atkinson and Power 1991). In 1993, based on observed fish movements, management units were redefined: **Unit 1** - 4RST and 3Pn4Vn from Jan. to May; **Unit 2** - 3Ps4VsWfgj, and 3Pn4Vn from June to Dec. Recent research however, has shown no genetic differences between Unit 1 and Unit 2 for each species. Two zonal reviews in 2010 concluded that Units 1 and 2 correspond to a single biological population of each species (DFO 2010, 2012). However, McAllister and Duplisea (2012) noted that “Other work indicates that the Unit 1 and Unit 2 area may have important substock structure and some components of the stock (Unit 1) appear to be more depleted than others….Fishing or allowable by-catch on this stock should account for its overall status as well as that of sub-components”. Units 1&2 are currently “assessed” as a single stock but they remain “managed" as separate stocks, i.e. separate TACs and separate quotas shares. Thus, even though Unit 1 and 2 are presently considered a single biological stock, it is deemed useful from a fishery management point of view to examine the Unit 2 portion on its own where fish appear less depleted than to the north.

Following on the re-definition of stock structure for Redfish in the Laurentian Channel and surrounding areas, starting in 1997, Fisheries and Oceans (DFO), Newfoundland and Labrador (NL) Region implemented a “Unit 2 redfish” survey in Div. 3Pn and 4V, to cover most of the remaining Unit 2 stock area within the Laurentian Channel and surrounding locations, in addition to the annual standard spring survey that covers most of Subdiv. 3Ps (an area consistently surveyed by DFO since 1972) but not all parts of the Laurentian Channel. However, this DFO Unit 2 survey ended in 2002.

The Groundfish Enterprise Allocation Council (GEAC) has operated industry redfish surveys in Unit 2 also since 1997, initially intended to be complementary to DFO “Unit 2 redfish surveys”. However, given that DFO has not conducted its Unit 2 (non-3Ps) portion of the survey since 2002, the GEAC surveys taking place in NAFO Subdiv. 3Pn, 3Ps, 4Vn, and 4Vs, during winter 1997, and summer/fall 1998 to 2001, 2003, 2005, 2007, 2009, 2011 and 2014 now provide the only available up to date data that covers much of the key areas of Unit 2.

The data collected during GEAC surveys have been analyzed and published providing survey results not only to industry but also to DFO, for their databases and assessment work. The information presented in this document follows on previous GEAC generated reports: for 1997-99 surveys (Power 1999), 2000 (McClintock 2000), 2001 (McClintock 2001), 2003 (McClintock 2003), 2005 (McClintock 2005) and 2007 (McClintock and Teasdale 2007). Based on data collected in 2009, 2011 and 2014 and consistent with surveys from previous years, this paper constitutes the ninth report describing results of the GEAC redfish survey series in Unit 2.

METHODS

GEAC has performed a series of surveys in Unit 2 with scientific guidance from DFO both in the design and execution. The Engel 170 survey gear was used for the GEAC Unit 2 survey (Table 1). However, DFO Unit 2 surveys done in 1997-2002 used a different gear, the Campelen 1800 survey trawl with a 12.7 mm liner in the lower 7 m of the codend. A stratified random survey design similar to that used by DFO (Smith and Somerton 1981) was applied to the GEAC surveys: using a subset of survey strata illustrated in Fig. 1c and listed in Table 2 and 3. DFO preselected sampling locations within each designated stratum and the survey attempted to sample each of those sites.

Fig. 1a shows the extent of Unit 2 and Fig. 1b shows depth contours and NAFO Divisions in relation to Unit 2. The GEAC surveys up to 2014 employed (45-50 m) large "Cape" class commercial trawlers (*MV Cape Beaver or Cape Ballard*) as the survey platforms: beginning in Dec 1997, switching to Aug and/or Sep annually from 1998 to 2001 (Table 1).

SURVEY IN 2009 AND 2011

During September/October 2009 and September/October 2011, the *Cape Ballard* deployed an Engel 170 trawl with a 30 mm liner in the lower 7 m of the codend and a 21 m (69 ft) wingspread, as was done on all previous Unit 2 GEAC surveys.

Comparative fishing trials were conducted in August 2000 between the *Cape Beaver* and the *CCGS Teleost* and these results were modeled to provide a length-based conversion of the GEAC series from 2000 on into Teleost/Campelen equivalents (Cadigan and Power 2010). However, it is the unconverted (raw) Engel data that are presented in this paper for all survey years as the data have yet to be converted for all years.

SURVEY IN 2014

With all the "Cape" class vessels decommissioned, the 2014 survey was undertaken by the M/V Nautical Legend, a 19 m vessel during August/September, 2014, a change from larger survey vessels used between 1997 and 2011. This most recent GEAC survey changed not only the survey platform but also gear. The new trawl and foot gear used were based on the DFO Campelen trawl but updated with current trawl materials and modified to fit the smaller vessel. The vertical and horizontal openings are the same as the DFO Campelen trawl described above. Details of the gear configurations and materials are available from GEAC and DFO.

Based on the comparative fishing work done in 2015, the wingspread of the GEAC Campelen was 49.87 feet (15.2 m). That was the wingspread used for the 2014 survey analysis using the STRAP routines. The wing spread of the previously used Engel survey trawl was 21 m.

In view of the smaller size of vessel used in 2014, and to be consistent with DFO surveys, trawl durations were set to 15 minutes and tow speeds were kept between 2.8 and 3.2 knots for that year. Survey tows were monitored using Netmind™ and eSonar™ net monitoring equipment.

All equipment was calibrated and tested prior to the survey. This industry Campelen gear employed in 2014 is much closer in terms of its configuration to the DFO Campelen survey gear than the Engel gear used in previous years. Comparative fishing trials with the DFO Campelen gear to calibrate catchability were completed in 2015 but analyses of these comparative data have yet to be undertaken undertaken.

SAMPLING

Catch numbers and weight of redfish were recorded for each set. Redfish in each set were counted, weighed and sampled for length (by 1 cm) and for sex during the 2009, 2011 and 2014 trips, similar to previous surveys. Because *S. mentella* and *S. fasciatus* are very similar and difficult to distinguish at sea, they were coded as a single entity for the purpose of the analysis. *S. marinus* were rare and were not recorded. Not differentiating *S. mentella and S. fasciatus* is consistent with previous years' analyses of GEAC survey data although DFO surveys in Unit 1 do differentiate between the two species by using fin ray count subsamples. McClintock and Teasdale (2009) did propose a method to apportion the GEAC 2007 abundance and biomass estimates into species components, for illustrative purposes but are not applied here.

CALCULATION OF BIOMASS AND ABUNDANCE

The set details and redfish length frequencies were exported from FFS (at sea data collection software, Fisheries Forms System) to create ASCII digital data files. Stratified random survey analysis was carried out using RStrap routine (STRAP programmed in R, R Core Team 2015) provided by DFO (based on Smith and Somerton 1981) and applying (subtracting) the French Exclusion Zone around St. Pierre et Miquelon for area calculations. All set catches using Engel gear (1997-2011) were standardized to a 30 minute tow and to a 15 minute tow for the 2014 Campelen survey.

RStrap was used to calculate STRAP2 (non-length based biomass and abundance output), on a stratum by stratum basis and overall, namely, the relative abundance and biomass, mean numbers and weight per tow and confidence intervals (CI). For the 2009 and 2011 survey data, a wingspread of 69 ft (21 m) (3.5 knots during a 30 minute tow) was used, consistent with the 1997-2007 Engel analyses, same as past years. For the 2014 Campelen survey, a wingspread of 49.87 ft (15.2 m) and tow length at 3 knots (a range of 2.8 and 3.2 knots) during a 15 minute tow) was used to calculate the swept area. Wingspread of 49.87 m was used based on the net parameter information from comparative fishing done in May 2015.

Length based output from STRAP includes stratum-by-stratum summaries of numbers at length separated by sex (male, female, unsexed) as well as overall sexes combined, including overall summaries of total numbers-at-length, mean numbers-at-length per tow and 95% CIs. Redfish were sampled in one cm length groupings and all ratio/percentages of catch measured were applied to provide a cm by cm estimate of catch.

Output from STRAP that were not available for years prior to 2011 included mean number and weight/tow and associated CIs for Unit 2 area as a whole and thus are not presented.

Distribution of the species was mapped using ACON for 1997-2009. For 2011 and 2014, SPANS GIS (Anon 1997) was used to map the distribution. Scale was maintained between the two systems.

Although the GEAC Unit 2 survey series now spans 17 years (11 sampled years), a number of inconsistences in the survey design have led to some limitations in interpreting the time series as a whole.

a) No liner was used in 1997 to 1999 and thus primarily large fish would have been captured in those years; most fish smaller than about 19 cm escaped through the larger mesh (refer to Fig. 5 and 6). That would affect catch rate.

b) Additional inshore strata SubDiv. 3Ps, strata, 295, 296, 298, 299 were sampled in 2007, 2009, 2011 and 2014 but not in previous years. The added strata were eliminated from RSTRAP analyses to ensure consistency among years. In 2014, stratum 309 was not sampled and stratum 452 was sampled only in certain years. No adjustments were made when those strata were missed, consistently with previous analyses.

c) Change in survey gear in 2014, from an Engel 170 used in previous years to a Campelen trawl in 2014, makes the 2014 numbers non-comparable to previous years. A number of factors, particularly smaller mesh size used for Campelen, lead to size specific differences in catchability between gears. The new GEAC Campelen gear likely has a substantially different q (catchability) compared to the previously used Engel gear, particularly in terms of abundance at length but it is similar to the DFO Campelen gear.

d) The initial survey in 1997 was conducted at a different time of year. This should not affect overall survey abundance estimates unless fish are moving into or outside of the survey footprint.

RESULTS AND DISCUSSION

Table 2 provides an inventory of the Unit 2 survey set details for 2009-2014, including catch weight per set. See (Power 1999), 2000 (McClintock 2000), 2001 (McClintock 2001), 2003 (McClintock 2003), 2005 (McClintock 2005) and 2007 (McClintock and Teasdale 2007) for inventories from previous surveys.

2009 SURVEY

Of the 140 planned survey stations, a total of 126 sets were attempted. Redfish were caught in all sets. Of those, 126 were successfully completed and 117 sets were used for STRAP analyses (Table 2a). The 9 sets not used for STRAP occurred within nearshore strata that were first added in 2007. Since those strata were not sampled in previous years, to ensure a consistent survey footprint, they were excluded.

Largest catches occurred in strata 707 and 708 in southern Subdiv. 3Ps (Table 2a, see Fig. 1b for location). The mean and median set catch numbers for the 2009 survey were 575 and 137 fish.

2011 SURVEY

A total of 138 of 140 planned sets were attempted. Of those, 136 were successfully completed and 127 sets were used for STRAP analyses (Table 2a). Redfish were caught in all sets. The nine sets that occurred within the nearshore strata that were first added in 2007 were excluded as was done for 2009.

Largest catches occurred in strata 452 and 399 in Subdiv. 4Vs and 708 in Subdiv. 3Ps as for 2009 in the southern extent of the survey area (Table 2b, see Fig. 1b for location). The mean and median set catch numbers for the 2011 survey was were 802 and 135 fish (compared with 575 and 137 in 2009).

2014 SURVEY

A total of 118 of 140 planned sets were attempted. Of those, 114 were successfully completed (Table 2c). Redfish were caught in all sets. Eight sets occurred within nearshore strata that were first added in 2007. As in previous years, they were excluded from the STRAP analysis.

Largest catches occurred in stratum 303 in Subdiv. 3Pn and 451 Subdiv. 4Vs. The mean and median set catch numbers were 351 and 72 fish. Catch for this survey is not comparable to earlier years due to the change in vessel/gear.

ALL YEARS

Table 3 shows mean catch per tow across all years of the GEAC survey by Subdiv. and by strata.

In 2009, the largest mean catch/tow, reflecting high local density, occurred in Subdiv. 3Ps in stratum 708 (highlighted by grey shade) at the bottom of the Halibut Channel and was more than four times greater than in any other stratum (see Fig. 1c). As a result, the highest Subdiv. catch rate was observed in 3Ps in 2009.

In 2011, local density was less concentrated and high catch rates were observed over a wider area. The largest catch rate again occurred in stratum 708 where catch rate was more than three times higher than any other stratum in 3Ps. However, relatively high rates were also observed in Subdiv. 4Vs primarily in strata 399, 452 and 468 (highlighted by grey shades). Those strata occur on the southern edge of the Scotian Shelf on the other side of the Laurentian Channel from St Pierre Bank and stratum 708 (see Fig. 1a).

Between 1997 and 2005, stratum 452 was not sampled but in 2007 and 2009 when it was sampled, the values were only about 14% of the 2011 value. In strata 399, the 2011 value was five times higher than in 2009. There was only one set in 468 in 2009 and thus no value is available for that area to compare. Over all years, strata 399 and 468 usually dominated within 4Vs.

On average, in 4Vs and 3Ps, particularly in strata near the mouth of the Laurentian Channel yield a greater portion of the biomass compared to the northern Subdivisions. Overall Unit 2 mean catch rate in 2009 was 172 kg/tow. The greatest consistent contribution of any stratum is from 708 by almost an order of magnitude more than any other stratum.

The survey results for 2014 cannot be directly compared to previous years in terms of their magnitude but as in previous years, the largest catches were taken in Subdiv. 4Vs and 3Pn but the difference was not as dominant (Table 3). The strata with the largest catch/tow were 309 and 707 in 3Ps and 451 and 468 in 4Vs. Catches were more evenly spread among strata than in previous years.

Unit 2 encompasses the outer reaches of the Laurentian Channel and surrounding shelf within Subdivisions 3Pn, 4Vn, 3Ps and 4Vs (Fig. 1). The Channel is a relatively flat deep trench with deepest locations of 450 m. Distribution of the catches is described by ACON plots (Fig. 1d) where catch for each survey location is depicted by expanding circles, larger circles, larger catches.

In all years large catches are observed along the shelf edge leading east and west away from both sides of the Channel and also sometimes at the Channel mouth (Fig. 1d). In 1997, 2000, 2007 and 2009, large catches were observed mid to south in the Laurentian Channel. From 2001-05 Channel catches were generally small. Only in one year, 1998 were large catches observed in the north adjacent to Unit 1. In 2009, the redfish were highly concentrated at the eastern and western edge of the mouth of the Laurentian Channel. In 2011, the observed distribution was unusual in that no large catches were observed within the Channel: nearly all biomass was concentrated along the shelf edge in 3Ps and 4Vs. In 2014, the catches were spread throughout much of the Channel and shelf edge. These interannual variations in distribution indicate that the fish regularly move around within the Unit area. It should be noted that the surveys did occur at a different time of year in December in 1997, then in August or August/September or September/October in subsequent years.

Figure 2 shows the mean weight per set together with 95% upper and lower confidence limits for the estimate. Mean values in 2009 range from 90 kg/tow in 4Vn to 146 and 149 kg in 4Vs and 3Pn respectively, to 252 kg/tow in 3Ps. In 4Vs, the mean weight/tow was 91% of the 2007 survey value. Mean weights all increased in 2009 in the other three Subdivisions: the 3Ps value increased 20%, the 4Vn value 30%, and the 3Pn value over four times. In 2011, catch rate was lower in 2 (3Ps, 3Pn) of four Subdivisions. Wide confidence intervals mean limited information on trends in the population.

Survey biomass and abundance are enumerated in Table 3 and illustrated in Fig. 3 by Subdiv. It is apparent that Subdiv. 3Pn, the smallest of the areas contains the least biomass and abundance: 4Vn and 4Vs, the southern extent of Unit 2 are about equally apportioned and on average contain about 76% of the abundance over the period of the surveys. With the highest values in 1997 and 1998, both biomass and abundance estimates have fluctuated without trend since about 2000. In Unit 2, the total biomass index appears to have fluctuated without trend since the early 2000s. For 2011 biomass was 119 kt up from 110 kt in 2009 but remains below the 2001 estimate of 141 kt. (Fig. 4). Because of the gear change in 2014, that year is not comparable to earlier years and thus the 2014 points are not joined to 2011 in Fig. 2 or Fig. 4.

All of the spatial changes illustrated in Table 3, Fig. 1d, Fig. 2 and Fig. 3 indicate that although the majority of the biomass and abundance usually resides in southern Unit 2 and redfish tend to shift about among the four Subdivisions that make up the stock area.

Figure 5 presents the redfish survey mean number at length by Subdiv. for each year of the Unit 2 surveys. Fish generally ranged between 15 and 45 cm with peaks in the upper range at about 30-40 cm. Exceptions were in 2001 in 3Pn, 2005 in 3Pn and 4Vn, in 2007 in 3Ps and 3Pn 4Vn in 2014 when smaller fish were observed. These smaller peaks are evidence of the presence of younger year classes in substantial numbers in those years and this is discussed in more detail with respect to Fig. 6 below.

Fig. 6 illustrates abundance at length by sex for each year of the survey. In most years, the length distribution generally peaked in the upper range of the length distribution, between 30 and 40 cm (fish mainly older than 15 years). A secondary smaller peak at about 25 cm was apparent in some years, evidence of the presence of younger fish (probably fish of about 8-13 years).

In 2005, a peak ranging from 7 to 11 cm (9 cm max) indicated the presence of much younger fish than previously observed, likely fish that were two year olds. Escapement of fish in this size range from the Engel gear is high given the larger mesh size and thus their presence in the net suggests very large numbers present in the water in that year. A large peak in the range of 12-18 cm (15 cm max) in 2007 likely is the same year class that was first observed in 2005, now two years older.

In 2009 there are three primary peaks evident. The largest is at 19 cm (for both male and females). A second peak is at 35 to 37 cm, and a lower, broader third peak is at 25 to 28 cm. A fourth very small peak is also evident at 15 cm. One can estimate, from average length at age based on research survey samples (data provided by Don Power) that these peaks might correspond to the 1985-89, 1998 year classes and the 2003 year class noted above.

In 2011, the largest peak at 22 cm (19-26 cm), likely comprising mainly nine year olds, corresponds again to that 2003 year class. Fish > 27 cm in 2011 were relatively at a much lower level of abundance indicating the importance of that 2002 year class in the population in that year. This suggests good recruitment occurred in 2002 and with that year class evident through to 2011, its persistence in the population.

In 2014, fish abundance in the range of 9-17 cm in length amounted to 263 million fish but only four million in 2011. However, with the change in survey gear in 2014, the numbers are not directly comparable – Campelen gear generally captures greater numbers of small fish. Fish in that size range captured in the survey were also scarce in previous years (with the exception of 2005 when a small peak of fish in that range was observed) when Engel gear was also used. This suggests the possibility of a large 2011 year class. Future surveys will determine if this is the case.

MANAGEMENT AREAS

Fishing effort in Unit 2 is managed spatially by the fishing industry to reduce the catch of *S. mentella* which is considered to be relatively less abundant than *S. fasciatus.* Current GEAC management measures allocate quota on the basis of statistical areas divided into two sectors, Northwest and Southeast areas (Table 4a). In 2011/2012, fishing effort by the >100' LOA fleet sector was allocated to Southeast area (3Psgh and 4Vsbc) where *S. fasciatus* is in greater proportion in the mix of the two species.

The effect of concentrating effort in a particular area was examined by calculating biomass and abundance (species combined) for each of the Southeast and Northwest management areas. In order to partition the abundance and biomass estimates by those areas, individual strata estimates, the basic units for calculating biomass and abundance from the stratified random survey design, were allocated to each statistical area. In some cases, strata straddle the statistical area boundaries (see red numbers in Tables 4a). When this occurred, biomass and abundance estimates within those strata were allocated by half (by 1/3rd in one case) to each statistical area that they overlapped. Given the gear change between 2011 and 2014, the results are not directly comparable. In 2011, biomass and abundance were roughly 50/50 between areas. In 2014, abundance was slightly higher in the SE while biomass was lower there (Table 4b, Fig. 7). In the Southeast sector, where fishing effort was purposely concentrated, the majority of biomass and abundance occurred in statistical area 4Vsc adjacent to the mouth of the Laurentian Channel.

SUMMARY

A full DFO assessment of Unit 2 redfish was last done in 2000 (Rice 2000), updates were last published in 2010 (DFO 2010) and 2012 (DFO 2012, Duplisea et al. 2012) and an RPA (Recovery Potential Assessment) was undertaken in 2012 (McAllister and Duplisea 2012). These most recent updates and the RPA incorporated data derived from the GEAC surveys up to 2009.

This paper updates the raw GEAC survey and STRAP information on Unit 2 redfish to 2014 and provides a comparison to previous year's survey results.

- In most years, largest catches were observed south in the Laurentian Channel and along the shelf edge. Only in 1998 were large catches observed in the north adjacent to Unit 1. Normally, nearly all biomass was concentrated along the shelf edge. Interannual variations in distribution indicate that the fish move around within the stock area but are generally more concentrated in the south.
- Overall, in Unit 2, the total biomass index has fluctuated without trend since the early 2000s. For 2011 biomass was 119 kt up from 110 kt in 2009 but remains below the 2001 estimate of 141 kt.
- Overall, in Unit 2, the total abundance index has fluctuated without trend since the early 2000s.The total abundance estimate of 372 M in 2011 is the highest since 2001 but remains well below 1997-98 values. However, the 1997 survey did occur at a different time of year and a liner was not used in 1997 to 1999 which may in part account for the higher values observed.

- In 2005, a peak at a length of nine cm was observed indicating the presence in large numbers of much younger fish than previously observed, likely fish that were two year olds. That peak persisted and increased in size through 2011. Fish > 27 cm in 2011 were relatively at a much lower level of abundance further indicating the importance of that 2003 year class in the population in that year. This suggested a significant 2003 year class. In 2014, a very large peak of fish at 9-17 cm possibly indicates a strong 2011 year class.
- On average in 2011 and 2014, both biomass and abundance were about equally distributed between the GEAC Southeast and Northwest management areas although it did vary between years. In the Southeast sector, the majority of biomass and abundance occurred in statistical area 4Vsc. A management implication is that the proportions may have changed over the last two surveys (three years) with a possible decrease in the proportion of the biomass and abundance in the southeast sector where the fishing effort has been concentrated since 2011/2012.

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APPENDIX I - TABLES

Table 1. GEAC Redfish Survey parameters, 1997-2014, "-" indicates a blank cell.

Year	Vessel	Vessel length	Period	Gear	Codend Liner	Wingspread	Tow Duration	Tow Speed
1997	Cape Beaver	40-45 m	Dec	Engel 170	none	21 m	30 min	3.5 kts
1998	Cape Ballard	40-45 m	Aug/Sep	Engel 170	none	21 m	30 min	3.5 kts
1999	Cape Beaver	40-45 m	Aug/Sep	Engel 170	none	21 m	30 min	3.5 kts
2000	Cape Beaver	40-45 m	Aug/Sep	Engel 170	30 mm	21 m	30 min	3.5 kts
2001	Cape Ballard	40-45 m	Aug/Sep	Engel 170	30 mm	21 m	30 min	3.5 kts
2002	*No survey*	-	-	-	-	-	-	-
2003	Cape Beaver	40-45 m	Aug/Sep	Engel 170	30 mm	21 m	30 min	3.5 kts
2004	*No survey*	-	-	-	-	-	-	-
2005	Cape Beaver	40-45 m	Aug/Sep	Engel 170	30 mm	21 m	30 min	3.5 kts
2006	*No survey*	-	-	-	-	-	-	-
2007	Cape Ballard	40-45 m	Sep/Oct	Engel 170	30 mm	21 m	30 min	3.5 kts
2008	*No survey*	-	-	-	-	-	-	-
2009	Cape Ballard	40-45 m	Sep/Oct	Engel 170	30 mm	21 m	30 min	3.5 kts
2010	*No survey*	-	-	-	-	-	-	-
2011	Cape Ballard	40-45 m	Sep/Oct	Engel 170	30 mm	21 m	30 min	3.5 kts
2012	*No survey*	-	-	-	-	-	-	-
2013	*No survey*	-	-	-	-	-	-	-
2014	Nautical legend	19 m	Aug/Sep	Campelen 1800	12.7 mm	15.2 m	15 min	2.8-3.2 kts

*Table 2a. Redfish catch details for GEAC stratified random survey sets, Unit 2, September **2009.** Num is actual number caught in the set, Wt is actual weight caught (not adjusted to standard tow). Latitude and longitude are in decimal degrees, "-" indicates a blank cell.*

Latitude	Longitude	Stratum	Div	Num	Wt (kg)	Trip	Set	Depth (m)	Bot Tem C
45.12	54.55	318	3Ps	661	118.2	201	1	393	-
45.04	54.74	707	3Ps	9,244	1,486.8	201	2	513	-
45.00	54.90	708	3Ps	17,708	4,897.3	201	3	476	-
45.03	55.44	708	3Ps	1,744	248.0	201	4	453	-
45.07	55.48	707	3Ps	2,189	295.0	201	5	319	-
45.07	55.48	707	3Ps	612	68.0	201	6	236	-
44.81	55.63	709	3Ps	36	6.5	201	7	636	-
44.90	56.05	316	3Ps	22	2.0	201	8	438	-
44.78	56.28	711	3Ps	2,440	1,459.0	201	9	458	-
44.70	56.43	398	4Vs	924	292.0	201	10	384	-
44.16	58.32	468	4Vs	115	17.0	201	11	470	-
44.19	58.32	451	4Vs	22	7.0	201	12	290	-
44.03	58.52	451	4Vs	2	2.0	201	13	237	-
44.29	59.03	452	4Vs	5	2.0	201	14	275	-
44.33	59.33	452	4Vs	536	33.0	201	15	223	-
44.30	59.33	452	4Vs	2,510	166.0	201	16	235	-
44.69	57.27	446	4Vs	0	0.0	201	17	286	-
44.77	57.18	399	4Vs	166	152.0	201	18	417	-
44.70	56.92	399	4Vs	828	456.0	201	19	421	-
44.73	56.92	398	4Vs	849	486.0	201	20	424	-
44.78	56.91	398	4Vs	52	33.0	201	21	424	-
44.85	56.83	398	4Vs	558	329.0	201	22	422	-
44.91	56.70	398	4Vs	458	264.0	201	23	418	-
45.03	56.43	711	3Ps	432	84.0	201	24	385	-
45.18	56.27	316	3Ps	26	6.0	201	25	231	-
45.14	56.72	711	3Ps	575	197.0	201	26	409	-
45.06	57.02	398	4Vs	484	308.0	201	27	439	-
44.96	57.27	399	4Vs	70	48.0	201	28	441	-
45.07	57.39	399	4Vs	45	21.0	201	29	443	-
45.15	57.22	398	4Vs	111	68.0	201	30	445	-
45.28	56.68	711	3Ps	249	68.0	201	31	390	-
45.30	56.50	706	3Ps	1,564	168.0	201	32	348	-
45.38	56.68	711	3Ps	218	90.0	201	33	389	-
45.31	57.10	397	4Vs	176	113.0	201	34	443	-
45.28	57.23	397	4Vs	60	41.0	201	35	448	-
45.25	57.36	400	4Vs	230	161.0	201	36	450	-
44.34	57.24	397	4Vs	86	59.0	201	37	447	-
45.55	56.79	712	3Ps	151	87.0	201	38	393	-
45.49	57.12	712	3Ps	1,810	1,238.1	201	39	434	-
45.41	57.38	397	4Vs	113	82.0	201	40	453	-
45.76	56.83	706	3Ps	1,000	118.0	201	41	329	-
45.87	56.99	706	3Ps	469	147.0	201	42	347	-
45.81	57.07	712	3Ps	239	143.0	201	43	415	-
45.63	57.33	712	3Ps	717	489.0	201	44	447	-
45.49	57.67	400	4Vs	164	112.0	201	45	429	-
45.48	57.85	446	4Vs	460	131.0	201	46	268	-
45.54	57.93	446	4Vs	258	39.0	201	47	231	-
45.68	57.56	415	4Vn	185	124.0	201	48	464	-
45.77	57.45	712	3Ps	151	96.0	201	49	455	-
45.88	57.25	712	3Ps	56	37.0	201	50	439	-
45.98	57.08	706	3Ps	352	37.0	201	51	325	-
46.11	57.14	313	3Ps	521	51.0	201	52	239	-
46.07	57.21	705	3Ps	287	43.0	201	53	341	-
46.09	57.61	713	3Ps	486	341.0	201	54	478	-
45.98	58.38	416	4Vn	3,570	395.0	201	55	295	-
46.07	58.53	416	4Vn	137	55.0	201	56	314	-
46.15	58.21	415	4Vn	146	95.0	201	57	425	-

Table 2a. Continued.

Latitude	Longitude	Stratum	Div	Num	Wt (kg)	Trip	Set	Depth (m)	Bot Tem C
46.15	59.00	713	3Ps	206	134.0	201	58	476	-
46.32	57.89	713	3Ps	173	117.0	201	59	468	-
46.38	57.59	713	3Ps	94	62.0	201	60	435	-
46.47	57.42	313	3Ps	145	26.0	201	61	210	-
46.55	57.56	705	3Ps	141	49.0	201	62	331	-
46.40	57.74	713	3Ps	90	76.0	201	63	473	-
46.35	58.00	713	3Ps	297	202.0	201	64	463	-
46.31	58.20	415	4Vn	354	252.0	201	65	444	-
46.31	58.31	415	4Vn	203	142.0	201	66	436	-
46.24	58.79	416	4Vn	101	72.0	201	67	319	-
46.41	58.50	415	4Vn	70	51.0	201	68	427	-
46.49	58.40	714	3Ps	45	34.0	201	69	447	-
46.44	58.27	714	3Ps	88	66.0	201	70	454	-
46.55	57.88	714	3Ps	65	44.0	201	71	457	-
46.62	57.78	714	3Ps	78	53.0	201	72	430	-
46.67	57.69	715	3Ps	296	148.0	201	73	341	-
46.63	58.12	714	3Ps	128	78.0	201	74	461	-
46.60	58.49	415	4Vn	328	225.0	201	75	434	-
46.66	58.67	415	4Vn	181	130.0	201	76	416	-
46.60	58.75	415	4Vn	114	84.0	201	77	416	-
46.60	58.83	415	4Vn	115	88.0	201	78	419	-
46.39	59.02	416	4Vn	49	40.0	201	79	303	-
46.42	59.17	417	4Vn	101	69.0	201	80	237	-
46.52	59.24	416	4Vn	41	28.0	201	81	311	-
46.71	59.28	415	4Vn	67	53.0	201	82	416	-
46.73	59.18	415	4Vn	85	71.0	201	83	436	-
46.87	58.63	714	3Ps	102	76.0	201	84	421	-
46.83	58.31	714	3Ps	65	49.0	201	85	463	-
46.90	57.96	715	3Ps	49	22.0	201	86	329	-
46.91	58.12	714	3Ps	90	62.0	201	87	464	-
46.91	58.25	714	3Ps	53	35.0	201	88	473	-
47.00	58.76	305	3Pn	106	83.0	201	89	433	-
46.84	59.42	415	4Vn	46	35.0	201	90	420	-
46.80	59.72	417	4Vn	54	27.0	201	91	246	-
46.93	59.42	415	4Vn	39	30.0	201	92	436	-
47.09	59.20	415	4Vn	18	14.0	201	93	452	-
47.15	59.14	305	3Pn	16	12.0	201	94	446	-
47.15	59.38	415	4Vn	20	16.0	201	95	461	-
47.07	59.41	415	4Vn	82	69.0	201	96	453	-
47.05	59.70	415	4Vn	72	59.0	201	97	430	-
47.04	60.02	417	4Vn	271	196.0	201	98	247	-
47.33	60.07	415	4Vn	240	180.0	201	99	405	-
47.48	60.01	415	4Vn	82	63.0	201	100	504	-
47.62	60.08	415	4Vn	27	24.0	201	101	517	-
47.64	60.01	415	4Vn	11	11.0	201	102	527	-
47.45	59.62	415	4Vn	29	25.0	201	103	481	-
47.37	58.47	415	4Vn	16	14.0	201	104	468	-
47.32	59.46	415	4Vn	13	10.0	201	105	469	-
47.32	59.39	305	3Pn	15	12.0	201	106	462	-
47.47	59.04	303	3Pn	607	137.0	201	107	209	-
47.40	59.01	305	3Pn	46	16.0	201	108	376	-
47.25	58.99	305	3Pn	21	15.0	201	109	421	-
47.30	58.94	305	3Pn	32	26.0	201	110	398	-
47.36	58.81	304	3Pn	38	29.0	201	111	287	-
47.35	58.70	303	3Pn	83	18.0	201	112	215	-
47.24	58.56	304	3Pn	1,101	614.0	201	113	322	-
47.28	57.89	306	3Ps	615	149.0	201	114	221	-
47.33	57.91	306	3Ps	330	30.0	201	115	220	-
47.41	57.98	303	3Pn	1,223	576.0	201	116	202	-
47.05	56.79	310	3Ps	729	59.0	201	117	202	-

*Table 2b. Set by set redfish catches for GEAC stratified random survey sets, Unit 2, September **2011.** Num is actual number caught in the set, Wt is actual weight caught. Latitude and longitude are in decimal degrees, "-" indicates a blank cell.*

Latitude	Longitude	Stratum	Div	Num	Wt (kg)	Trip	Set #	Depth (m)	Bot Tem C
44.2283	59.5783	452	4V	167	8.1	202	1	216	5.2
44.2467	59.3700	452	4V	7,025	681.0	202	2	248	5.8
44.2067	59.3633	452	4V	2,721	555.1	202	3	250	5.4
43.9583	58.7100	451	4V	32	5.4	202	4	192	8.4
44.2233	58.4333	451	4V	317	153.7	202	5	209	6.9
44.3250	57.5567	468	4V	24	10.1	202	6	558	5.2
44.4450	57.2167	468	4V	4,567	1,346.1	202	7	450	-
44.5233	57.0483	399	4V	8,406	2,053.1	202	8	382	3
44.7783	56.8617	398	4V	1,178	252.9	202	9	422	5
44.6700	57.2433	446	4V	4,453	1,610.9	202	10	274	6.4
44.7450	57.1933	399	4V	1,862	206.4	202	11	415	5.1
44.8633	57.3150	399	4V	2,943	307.1	202	12	387	5.6
44.9650	57.2467	399	4V	164	79.7	202	13	445	5
45.2183	57.5383	400	4V	82	67.4	202	14	405	5.2
45.3650	57.5033	397	4V	116	85.5	202	15	456	5
45.4067	57.7017	400	4V	104	65.6	202	16	389	5.3
45.4100	57.7650	446	4V	340	97.6	202	17	281	3
45.6750	57.9783	446	4V	32	5.0	202	18	308	5.7
46.0400	58.6483	417	4U	603	188.0	202	19	209	-
46.1517	58.5617	416	4U	351	168.4	202	20	345	-
46.2983	58.5267	415	4U	272	154.4	202	21	399	-
46.6000	58.6400	415	4U	317	240.9	202	22	413	2.6
46.5700	58.8700	415	4U	154	117.2	202	23	415	5
46.7683	58.9283	415	4U	124	90.1	202	24	437	5.1
46.7650	58.8650	415	4U	92	65.0	202	25	429	5.1
46.8033	58.9200	415	4U	66	48.5	202	26	437	5.1
46.8183	59.0600	415	4U	68	51.7	202	27	442	5.2
46.8733	59.1817	415	4U	59	43.9	202	28	451	5
46.7933	59.2983	415	4U	112	80.8	202	29	430	5.1
46.6500	59.4183	416	4U	85	83.2	202	30	336	5.7
46.7400	59.5200	416	4U	69	54.8	202	31	358	5.9
46.7717	59.5033	415	4U	48	38.3	202	32	379	5.4
46.8600	59.7433	416	4U	131	92.3	202	33	305	5.6
46.9250	59.8783	417	4U	200	138.5	202	34	225	6.1
46.9350	59.6150	415	4U	77	61.2	202	35	411	5.3
46.9883	59.4467	415	4U	43	33.4	202	36	440	5.3
47.1350	59.4600	415	4U	38	28.1	202	37	463	5.2
47.2317	59.5450	415	4U	30	24.1	202	38	471	5.1
47.1450	60.0100	416	4U	46	25.9	202	39	345	5.3
47.2250	60.2883	417	4U	51	9.9	202	40	196	5.9
47.2933	60.0500	415	4U	56	32.7	202	41	411	5.5
47.4117	60.1633	415	4U	497	344.5	202	42	414	5.4
47.4600	60.0400	415	4U	72	52.0	202	43	487	5.2
47.4483	59.9483	415	4U	41	32.3	202	44	502	5.1
47.4250	59.7417	415	4U	27	20.9	202	45	486	5
47.5333	59.9983	415	4U	63	53.4	202	46	511	-
47.7650	60.0300	415	4U	18	15.3	202	47	519	2.5
47.5867	59.4633	305	3Q	107	82.6	202	48	279	5.6
47.5967	59.3700	304	3Q	204	58.8	202	49	274	6.2
47.2633	59.2683	305	3Q	55	38.1	202	50	454	5.1
47.4050	58.8333	303	3Q	163	59.9	202	51	225	5.5
47.3650	58.8167	304	3Q	116	59.4	202	52	297	6.3
47.1750	59.1083	305	3Q	69	53.6	202	53	443	5.1
47.1117	59.0667	305	3Q	73	51.2	202	54	452	5.1
47.1767	58.9017	305	3Q	85	63.2	202	55	426	-
47.0050	58.8533	305	3Q	143	105.6	202	56	437	5.1
46.8700	58.7083	714	3P	232	176.5	202	57	423	5
46.8550	58.6167	714	3P	288	216.1	202	58	421	-
47.2400	58.3683	303	3Q	176	105.9	202	59	242	6.1
47.3950	58.1717	303	3Q	58	25.5	202	60	223	6.1
47.4600	58.0117	303	3Q	193	114.9	202	61	241	6.2
47.4217	57.9883	303	3Q	139	25.6	202	62	212	6.1

Table 2b. Continued.

Latitude	Longitude	Stratum	Div	Num	Wt (kg)	Trip	Set #	Depth (m)	Bot Tem C
47.2467	58.0767	306	3P	38	17.4	202	63	224	6.2
47.1683	58.1867	306	3P	102	26.3	202	64	223	6.7
47.1233	58.1917	306	3P	243	128.9	202	65	241	5.7
47.0983	58.2500	715	3P	700	384.5	202	66	330	5.5
47.0400	58.3617	714	3P	116	78.0	202	67	454	5
46.7933	58.0583	714	3P	68	46.2	202	68	467	-
46.7133	58.0817	714	3P	94	61.8	202	69	464	-
46.7067	58.2650	714	3P	147	103.1	202	70	461	2.4
46.7583	58.3967	714	3P	128	94.8	202	71	468	-
46.5683	58.4100	714	3P	92	64.8	202	72	455	5.2
46.4567	58.3300	415	4U	99	69.6	202	73	451	-
46.4267	58.1317	714	3P	57	41.2	202	74	459	-
46.2083	58.1050	415	4U	1,315	912.7	202	75	452	5.3
46.2317	57.9367	713	3P	213	149.8	202	76	466	4.8
46.2867	57.4533	705	3P	110	64.7	202	77	382	5.8
46.3167	57.7033	713	3P	74	49.2	202	78	478	4.9
46.3983	57.8917	713	3P	90	61.9	202	79	478	4.8
46.4583	57.7200	713	3P	94	62.9	202	80	472	5
46.5333	57.7933	713	3P	65	45.3	202	81	464	6.1
46.6317	57.7250	715	3P	78	53.9	202	82	395	5.6
46.7300	57.6167	313	3P	95	45.0	202	83	312	6.1
46.6883	57.4400	313	3P	49	16.4	202	84	225	7.3
46.7700	57.3850	310	3P	36	14.1	202	85	245	7.1
46.9633	57.2050	716	3P	346	114.2	202	86	290	6.4
47.0733	57.0517	716	3P	103	51.4	202	87	337	6.3
47.1150	57.0483	716	3P	44	25.0	202	88	342	5.9
47.1450	57.2733	309	3P	517	248.4	202	89	286	6
46.0467	57.0250	313	3P	75	13.7	202	101	247	7.5
46.0417	57.1383	705	3P	312	93.5	202	102	329	6.5
46.0217	57.5850	713	3P	167	117.6	202	103	481	1.4
46.0150	57.6833	713	3P	145	102.3	202	104	495	4.9
45.9733	57.8483	415	4U	135	93.2	202	105	501	5.1
45.9083	57.5650	712	3P	125	90.7	202	106	477	5.1
45.9267	57.3750	712	3P	107	64.9	202	107	455	5.1
45.9167	57.0667	706	3P	133	64.4	202	108	363	6
45.8333	56.9050	706	3P	368	76.3	202	109	319	6.4
45.7667	56.9717	712	3P	115	48.3	202	110	390	4.6
45.7700	57.1233	712	3P	100	53.1	202	111	428	5.1
45.7367	57.3400	712	3P	24	15.4	202	112	450	5.1
45.5367	57.5183	397	4V	152	103.3	202	113	462	5.2
45.4783	57.4100	397	4V	337	241.1	202	114	455	-
45.4050	57.2367	397	4V	165	93.0	202	115	444	-
45.5250	56.9617	712	3P	193	94.0	202	116	409	-
45.3533	56.8233	711	3P	125	65.6	202	117	408	-
45.4633	56.4800	316	3P	71	12.8	202	118	230	8
45.3750	56.5000	706	3P	414	65.4	202	119	328	6.5
45.3017	56.4567	706	3P	368	68.6	202	120	340	6.5
45.2633	56.5817	711	3P	215	45.1	202	121	388	5.8
45.1400	56.8117	398	4V	219	77.6	202	122	419	5.4
45.0233	56.9500	398	4V	125	75.7	202	123	433	5
44.9767	56.9533	398	4V	135	82.5	202	124	436	5
45.0700	56.7267	711	3P	276	100.4	202	125	413	5
45.1100	56.5933	711	3P	133	32.6	202	126	401	5.3
45.0000	56.6500	398	4V	288	70.9	202	127	411	-
44.9150	56.7367	398	4V	71	24.8	202	128	419	7.4
44.9017	56.6150	398	4V	487	92.8	202	129	406	-
44.9267	56.4617	711	3P	443	69.5	202	130	391	6.5
44.9150	56.0767	316	3P	186	53.5	202	131	187	6.3
44.9117	55.8350	318	3P	88	11.6	202	132	206	6.3
45.0400	55.4250	707	3P	390	98.5	202	133	301	6.2
44.9783	55.3033	708	3P	6,927	2,459.5	202	134	364	6.1
45.0683	55.1867	709	3P	38	17.5	202	135	617	4.6
45.1067	55.1167	318	3P	1,789	502.0	202	136	203	8.5

Table 2b. Continued.

Latitude	Longitude	Stratum	Div	Num	Wt (kg)	Trip	Set #	Depth (m)	Bot Tem C
45.0300	54.7767	708	3P	486	130.9	202	137	465	5.5
45.0867	54.6333	318	3P	259	88.2	202	138	176	11.8
45.0500	54.6017	707	3P	3,273	947.6	202	139	283	7.8
44.9967	54.5200	709	3P	175	58.2	202	140	636	11.6

Table 2c. Set by set redfish catches for GEAC stratified random survey sets, Unit 2, September ***2014.*** *Num is actual number caught in the set, Wt is actual weight caught. Latitude and longitude are in decimal degrees, "-" indicates a blank cell.*

Latitude	Longitude	Stratum	Div	Num	Wt (kg)	Trip	Set #	Depth (m)	Bot Tem C
47.1550	56.8583	716	3Ps	84	57.0	8	11	340	-
47.1950	57.3000	309	3Ps	949	71.0	8	12	234	-
47.0917	57.3533	716	3Ps	316	86.0	8	13	285	-
46.9350	57.3083	716	3Ps	59	19.0	8	14	319	-
46.8883	57.2783	310	3Ps	65	26.0	8	15	266	-
46.9100	57.1017	310	3Ps	1	1.0	8	16	209	-
46.7917	57.6750	716	3Ps	1,722	353.0	8	17	302	-
56.8583	57.8750	309	3Ps	1,082	413.0	8	18	302	-
46.8150	57.9283	714	3Ps	1	1.0	8	19	420	-
46.8267	48.0933	714	3Ps	47	20.0	8	20	469	-
46.6583	58.2067	714	3Ps	31	20.0	8	21	460	-
46.6650	57.8217	714	3Ps	6	2.0	8	22	434	-
46.6617	57.6900	715	3Ps	33	15.0	8	23	348	-
46.4067	57.6317	713	3Ps	4	3.0	8	24	456	-
46.4350	57.4150	313	3Ps	296	31.0	8	25	248	-
46.3367	57.3167	313	3Ps	1,133	103.0	8	26	213	-
46.0817	57.2017	705	3Ps	1,214	205.0	8	27	319	-
46.0867	57.2700	705	3Ps	290	72.0	8	28	352	-
46.0017	57.2483	712	3Ps	22	7.0	8	29	404	-
46.0267	57.0583	713	3Ps	42	22.4	8	30	467	-
46.1467	57.7167	713	3Ps	35	19.0	8	31	478	-
45.9300	57.7300	713	3Ps	35	20.8	8	32	492	-
45.8617	57.8067	415	4Vn	2	2.0	8	33	492	-
45.7433	57.3483	712	3Ps	38	27.2	8	34	449	-
45.8433	57.2967	712	3Ps	27	16.0	8	35	447	-
45.9750	57.1050	706	3Ps	115	30.7	8	36	350	-
45.9233	56.8900	316	3Ps	237	33.6	8	37	226	-
45.6300	65.6217	316	3Ps	357	61.0	8	38	227	-
45.5617	56.7067	706	3Ps	55	13.0	8	39	360	-
45.5967	57.0867	712	3Ps	26	11.0	8	40	424	-
45.4517	56.9317	712	3Ps	99	25.0	8	41	415	-
45.4033	57.0200	712	3Ps	156	49.0	8	42	430	-
45.3500	57.1100	397	4Vs	584	240.0	8	43	434	-
45.3483	57.3400	397	4Vs	57	32.0	8	44	451	-
45.3117	57.3433	397	4Vs	21	12.0	8	45	450	-
45.3917	57.6633	400	4Vs	53	24.0	8	46	414	-
45.5633	54.7517	400	4Vs	37	27.0	8	47	424	-
45.7417	58.0833	417	4Vn	1,235	446.0	8	48	218	-
45.9767	58.4700	417	4Vn	160	53.0	8	49	226	-
46.1517	58.6850	416	4Vn	354	23.0	8	50	301	-
46.3067	58.8933	416	4Vn	393	20.0	8	51	307	-
46.3500	58.8567	416	4Vn	140	20.0	8	52	348	-
46.3833	58.8633	416	4Vn	29	10.7	8	53	359	-
46.4567	58.7650	415	4Vn	92	57.0	8	54	404	-
46.5450	58.8800	415	4Vn	35	20.0	8	55	405	-
46.6867	58.8783	415	4Vn	30	19.0	8	56	424	-

Table 2c. Continued.

Latitude	Longitude	Stratum	Div	Num	Wt (kg)	Trip	Set #	Depth (m)	Bot Tem C
46.6517	58.9733	415	4Vn	25	8.0	8	57	424	-
46.5300	59.2467	416	4Vn	53	10.0	8	58	303	-
46.4333	59.1767	417	4Vn	114	7.0	8	59	574	-
46.7567	59.3450	415	4Vn	53	24.0	8	60	415	-
46.9533	59.1417	415	4Vn	33	18.0	8	61	455	-
46.9933	58.9317	305	3Pn	20	11.0	8	62	441	-
47.1300	59.1817	415	4Vn	31	12.0	8	63	450	-
47.0067	59.2433	411	4Vn	65	47.0	8	64	450	-
47.2450	59.6600	415	4Vn	38	22.4	8	66	473	-
47.3383	59.7650	415	4Vn	10	8.0	8	67	479	-
47.4500	59.8000	415	4Vn	5	4.0	8	68	270	-
47.4933	59.7250	415	4Vn	2	2.0	8	69	270	-
47.5417	59.8267	415	4Vn	4	4.0	8	70	514	-
47.6083	59.8350	415	4Vn	26	20.8	8	71	532	-
47.7733	60.0183	415	4Vn	24	7.0	8	72	522	-
47.5517	59.2800	303	3Pn	5,580	280.0	8	73	238	-
47.3900	59.5533	415	4Vn	53	3.0	8	74	476	-
47.4000	59.4150	305	3Pn	12	5.0	8	75	459	-
47.3133	59.1350	305	3Pn	1	2.0	8	76	432	-
47.3583	58.8050	304	3Pn	460	37.0	8	77	299	-
47.5083	58.3250	303	3Pn	51	5.0	8	78	203	-
47.3683	58.1550	303	3Pn	454	37.0	8	79	212	-
47.2117	58.4750	304	3Pn	370	166.0	8	80	333	-
47.1100	58.2850	715	3Ps	344	139.0	8	81	331	-
47.0717	58.1350	306	3Ps	227	98.0	8	82	235	-
46.4600	58.0650	714	3Ps	62	41.0	8	84	464	-
46.3750	58.1333	713	3Ps	74	53.0	8	85	458	-
46.2667	58.1533	415	4Vn	181	117.0	8	86	443	-
46.2567	57.8950	713	3Ps	34	21.0	8	87	464	-
46.2550	57.7533	713	3Ps	33	21.0	8	88	468	-
45.3400	56.8150	711	3Ps	213	50.0	8	89	404	-
45.2250	56.5950	711	3Ps	512	87.0	8	90	390	-
45.1133	56.7767	398	4Vs	72	13.3	8	91	415	-
45.0750	56.7100	711	3Ps	420	95.0	8	92	413	-
45.0033	56.5600	711	3Ps	260	49.0	8	93	404	-
44.9800	56.6883	398	4Vs	225	59.0	8	94	431	-
44.8083	56.7767	398	4Vs	224	51.0	8	95	413	-
44.9767	57.0217	398	4Vs	43	25.0	8	96	437	-
45.1533	57.1150	398	4Vs	161	85.0	8	97	439	-
45.2267	57.1833	397	4Vs	28	16.0	8	98	445	-
45.1417	57.5133	399	4Vs	72	17.0	8	99	375	-
45.1067	57.5550	446	4Vs	1,254	79.0	8	100	290	-
45.0267	57.4367	446	4Vs	920	121.6	8	101	354	-
44.9000	57.2783	399	4Vs	11	2.0	8	102	430	-
44.6333	57.2233	446	4Vs	1,298	133.0	8	103	276	-
44.3983	57.3383	451	4Vs	2,730	332.6	8	104	302	-
44.3833	57.3817	468	4Vs	1,541	380.0	8	105	436	-
44.1517	58.4183	468	4Vs	138	59.0	8	106	418	-
44.1850	58.2050	451	4Vs	919	111.0	8	107	274	-
44.5600	57.1217	399	4Vs	813	136.0	8	108	388	-
44.6750	57.0267	399	4Vs	121	34.0	8	109	413	-
44.7200	56.5650	398	4Vs	170	38.0	8	110	395	-
44.8917	55.6900	707	3Ps	1,562	339.0	8	111	290	-
45.0217	55.4367	708	3Ps	967	245.0	8	112	457	-
45.0883	55.1750	708	3Ps	609	112.0	8	113	438	-
45.0800	55.0300	707	3Ps	1,488	397.0	8	114	308	-
45.1017	55.0167	318	3Ps	615	125.0	8	115	200	-
45.0117	54.9000	708	3Ps	302	52.0	8	116	402	-
45.0800	54.7900	707	3Ps	529	78.7	8	117	281	-
45.0800	54.8333	318	3Ps	217	26.0	8	118	217	-

Table 3. Mean weight (kg) of redfish caught per standard 30 minute tow in 1997 to 2011, 15 minute tow in 2014 and survey biomass in Unit 2 during GEAC surveys. "" indicates strata not sampled, "x" indicates strata with less than 2 sets, "†" indicates high catch rates, and "-" indicates a blank cell. Total abundance estimates are noted at the bottom of the table.*

Div.	Depth Range	Area	Engel unconverted 1997	Successful sets	Engel unconverted 1998[2]	Successful sets	Engel unconverted 1999[2]	Successful sets	Engel unconverted 2000	Successful sets	Engel unconverted 2001	Successful sets	Engel unconverted 2003[2]	Successful sets	Engel unconverted 2005[1]	Successful sets	Engel unconverted 2007	Successful sets	Engel unconverted 2009	Successful sets	Engel unconverted 2011	Successful sets	Campelen 2014	Successful sets
STRAT.	**(m)**	**sq. nmi.**	Dec - 12	-	Aug 16-23	-	Aug 31-Sep 9	-	Aug 15-23	-	Sep 10-18	-	Aug 26-Sep 5	-	Aug 17-26	-	Sep 20-Oct 7	-	Sep 15-28	-	Aug	-	Aug	-
3Pn	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
303	185-274	554	187.8	2	651.2	2	271.4	3	50.9	3	89.7	3	195.7	4	244.6	3	54.9	5	255.3	3	75.56	5	107.3	3
304	275-366	151	194.2	2	49.8	2	36.3	2	388.5	2	27.5	2	79.7	2	63.0	2	12.3	2	340.4	2	66.48	2	101.5	2
305	367+	733	27.2	2	76.8	2	66.7	4	58.8	4	61.9	4	48.8	3	194.9	5	24.6	6	28.7	6	75.66	6	6.0	3
kg/tow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	-	13	-	8
Upper	-	-	828.3	-	982.8	-	414.4	-	175.8	-	147.5	-	250.2	-	447.0	-	74.4	-	480.1	-	98.67	-	193.7	-
Mean	-	-	108.4	-	126.7	-	143.3	-	90.4	-	69.0	-	108.6	-	200.2	-	35.0	-	148.7	-	74.67	-	55.3	-
Lower	-	-	-611.6	-	-729.4	-	-127.9	-	5.0	-	-9.5	-	-33.0	-	-46.6	-	-4.4	-	-182.6	-	50.68	-	-83.1	-
Biomass (t)	-	-	7,630	-	8,918	-	9,981	-	6,362	-	4,858	-	7,646	-	14,092	-	2,464	-	10,469	-	5,202	**-**	**11,996**	**-**
3Ps	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
306	185-274	363	0.1	2	11.7	2	9.2	2	54.5	2	100.6	2	81.0	2	25.5	2	126.9	3	94.8	2	79.09	2	-	-
309	185-274	296	10.7	2	106.4	2	328.7	2	149.0	2	249.9	2	98.5	2	x	1	93.8	2	*	-	-	-	242.0†	2
310	185-274	170	*	-	20.7	2	8.4	2	70.5	2	42.9	2	10.9	2	x	1	104.9	2	x	1	-	-	13.5	2
313	185-274	165	10.6	2	10.6	2	5.0	2	33.0	2	40.8	2	21.0	2	x	1	321.2	2	39.3	2	28.51	3	67.0	2
316	185-274	189	40.6	2	68.3	2	19.1	2	104.5	2	66.2	2	84.8	2	292.7	2	16.6	2	4.2	2	37.32	2	47.3	2
318	185-274	129	1697.5	2	*	-	173.6	2	71.0	2	47.1	2	344.1	2	416.5	2	*	-	x	1	225.67	3	75.5	2
705	275-366	195	105.8	2	29.1	2	32.5	2	56.6	2	18.5	2	38.6	2	40.2	2	*	-	48.7	2	92.48	2	138.5	2
706	275-366	476	*	-	97.4	2	58.3	3	49.3	3	120.4	3	84.1	2	65.5	3	63.8	4	121.9	4	77.59	4	21.8	2
707	275-366	74	707.3	2	931.2	2	212.6	2	373.5	2	169.4	2	721.1	2	328.9	2	*	-	685.7	3	560.78	2	271.6†	3
715	275-366	128	204.3	2	397.1	2	249.5	2	108.0	2	446.1	2	45.0	2	51.0	2	89.6	3	85.7	2	378.39	2	77.0	2
716	275-366	539	*	-	195.4	2	64.8	3	80.0	3	163.4	3	28.2	3	84.7	3	278.7	4	*	-	70.92	3	128.8	4
708	367-549	126	1267.8	2	995.3	2	1906.0	2	1104.5	2	382.2	2	238.5	2	719.6	2	2963.6	2	2903.5†	2	1,809.80†	2	136.3	3

Table 3. Continued.

Div.	Depth Range	Area	Engel unconverted 1997	Successful sets	Engel unconverted 1998[2]	Successful sets	Engel unconverted 1999[2]	Successful sets	Engel unconverted 2000	Successful sets	Engel unconverted 2001	Successful sets	Engel unconverted 2003[2]	Successful sets	Engel unconverted 2005[1]	Successful sets	Engel unconverted 2007	Successful sets	Engel unconverted 2009	Successful sets	Engel unconverted 2011	Successful sets	Campelen 2014	Successful sets
711	367-549	593	482.1	2	173.1	2	75.0	3	172.3	3	191.3	3	96.7	3	144.9	4	112.9	5	401.1	5	72.61	5	64.7	3
712	367-549	731	74.5	3	160.4	2	66.0	4	190.8	4	119.4	4	91.4	4	98.0	4	431.0	6	368.8	6	70.78	6	22.5	6
713	367-549	851	1285.5	4	31.1	3	127.0	5	113.6	5	43.2	5	67.1	5	86.2	5	84.7	6	163.2	6	96.41	7	22.9	7
714	367-549	1047	236.2	3	312.4	3	99.3	6	64.7	6	63.0	6	28.5	6	58.0	6	45.2	9	58.5	9	112.95	9	14.0	6
709	550-731	147	*	-	*	-	*	-	*	-	*	-	*	-	*	-	-	-	x	1	43.23	2	-	-
kg/tow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	48	-	55	-	56
Upper	-	-	903.1	-	267.4	-	553.2	-	184.2	-	162.6	-	108.2	-	155.1	-	297.8	-	602.7	-	436.22	-	89.9	-
Mean	-	-	444.4	-	173.3	-	130.0	-	127.6	-	117.5	-	80.3	-	113.2	-	214.1	-	252.0	-	135.86	-	56.1	-
Lower	-	-	-14.2	-	79.2	-	-293.1	-	71.0	-	72.3	-	52.3	-	71.4	-	130.4	-	-98.7	-	-164.51	-	22.3	-
Biomass (t)	-	-	106,329	-	50,412	-	38,828	-	37,916	-	34,919	-	23,853	-	30,161	-	59,463	-	60,914	-	38,442	**-**	**54,717**	**-**
4Vn	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
417	185-274	387	17.9	2	892.6	2	332.1	2	108.5	2	85.8	2	76.9	2	x	1	206.6	2	103.1	3	118.3	3	168.7	3
416	275-366	671	73.7	2	242.5	2	118.6	4	83.8	4	134.7	4	83.3	4	203.2	3	55.3	5	119.8	5	97.0	5	16.7	5
415	367-532	2915	416.7	7	347.6	8	90.0	16	195.5	16	68.9	15	81.6	16	81.9	18	53.8	24	81.7	24	128.5	24	20.5	17
kg/tow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	32	-	32	-	25
Upper	-	-	1010.0	-	648.2	-	143.5	-	287.5	-	122.1	-	107.9	-	198.4	-	110.0	-	126.3	-	188.4	-	84.8	-
Mean	-	-	319.9	-	382.9	-	118.4	-	168.2	-	81.7	-	81.4	-	104.6	-	69.0	-	90.2	-	122.2	-	34.3	-
Lower	-	-	-370.2	-	117.6	-	93.4	-	48.9	-	41.2	-	55.0	-	10.8	-	28.0	-	54.2	-	56.0	-	-16.3	-
Biomass (t)	-	-	62,219	-	74,474	-	23,034	-	32,714	-	15,881	-	15,841	-	18,358	-	13,412	-	17,548	-	23,768	**-**	**20,758**	**-**
4Vs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
446	185-366	313	32.4	2	3550.8	2	55.0	2	542.5	2	176.8	2	19.1	2	290.01	2	142.0	3	60.0	3	645.0	3	111.2	3
451	185-366	147	1995.7	3	*	-	*	-	56.0	2	1012.2	2	1358.5	2	235.59	2	189.8	2	4.7	2	176.1	2	221.8†	2
452	185-366	345	*	-	*	-	*	-	*		*	-	*	-	*	-	69.9	3	67.0	3	483.8†	3	-	-
397	367-549	540	1403.5	3	279.0	2	79.5	3	1003.7	3	76.9	3	220.6	3	110.7	3	94.2	4	78.1	4	149.0	4	75.0	4
398	367-549	833	51.1	4	558.4	3	232.0	5	258.7	6	240.4	6	154.0	5	197.1	5	208.8	7	261.6	7	112.7	7	45.2	6
399	367-549	465	56.3	3	132.4	2	88.0	3	1378.5	2	2443.4	2	443.6	3	500.5	3	275.2	4	181.4	4	780.9†	4	47.3	4

Table 3. Continued.

Div.	Depth Range	Area	Engel unconverted 1997	Successful sets	Engel unconverted 1998[2]	Successful sets	Engel unconverted 1999[2]	Successful sets	Engel unconverted 2000	Successful sets	Engel unconverted 2001	Successful sets	Engel unconverted 2003[2]	Successful sets	Engel unconverted 2005[1]	Successful sets	Engel unconverted 2007	Successful sets	Engel unconverted 2009	Successful sets	Engel unconverted 2011	Successful sets	Campelen 2014	Successful sets
400	367-549	270	36.6	2	78.4	2	96.5	2	138.5	2	61.4	2	60.8	2	62	2	78.2	2	144.5	2	77.2	2	25.5	2
468	367-549	148	1077.6	2	*	-	*	-	1796	2	1011.2	2	235.1	2	x	1	*	-	x	1	813.7†	2	219.5†	2
kg/tow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	26	-	27	-	23
Upper	-	-	828.8	-	6604.9	-	206.6	-	1924.1	-	2055.4	-	514.7	-	490.7	-	246	-	203.9	-	626.8	-	116.5	-
Mean	-	-	478.5	-	747.6	-	132.3	-	692.1	-	643.7	-	261.6	-	233.2	-	161.5	-	146.3	-	350.7	-	76.2	-
Lower	-	-	128.1	-	-5109.7	-	58	-	-540	-	-767.9	-	8.5	-	-24.3	-	76.9	-	88.6	-	74.5	-	35.9	-
Biomass (t)	-	-	63,619	-	88,601	-	15,684	-	92,020	-	85,593	-	34,782	-	29,315	-	23,027	-	20,856	-	52,547	-	**31,535**	-
Total # Sets	-	-	-	66	-	61	-	90	-	94	-	93	-	93	-	92	-	119	-	117	-	**127**	-	**112**
Mean wt/tow (kg)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	172.1	-	53.8	-
Tot Surv Biomass (t)	-	-	239,797	-	222,405	-	87,527	-	169,012	-	141,251	-	82,122	-	91,926	-	98,367	-	109,787	-	119,959	-	**119,006**	-
Mean number/tow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**534**	-	293.7	-
Tot Abundance (millions)	-	-	**486**	-	**497**	-	**182**	-	**318**	-	**404**	-	**175**	-	**299**	-	**336**	-	**300**	-	**372**	-	**649**	-
% difference compared to the previous year - **Biomass**	-	-	-	-	-8%	-	-154%	-	48%	-	-20%	-	-72%	-	11%	-	7%	-	10%	-	8%	-	-	-
% difference compared to the previous year - **Abundance**	-	-	-	-	2%	-	-173%	-	43%	-	21%	-	-131%	-	41%	-	11%	-	-12%	-	19%	-	-	-

1 – 2005 estimates from original CSAS Res Doc 2006/078 were updated in 2007 (see text in 2009/094)

Table 4a. Redfish abundance and biomass delineated by Strata within Northwest (NW) and Southeast (SE) Industry Management areas. Biomass is expressed in metric tonnes, abundance in numbers/1000. In some cases, strata straddle the statistical area boundaries, illustrated in red and "". "-" indicates a blank cell.*

2011 (NW) Div./SA Stratum	2011 (NW) Biomass	2011 (NW) Abundance	2011 (NW) # sets	2011 (SE) Div./SA Stratum	2011 (SE) Biomass	2011 (SE) Abundance	2011 (SE) # sets	2014 (NW) Div./SA Stratum	2014 (NW) - Biomass	2014 (NW) Abundance	2014 (NW) # set s	2014 (SE) Div./SA Stratum	2014 (SE) Biomass	2014 (SE) Abundance	2014 (SE) # sets
3Pn	**5,202**	**9,422**	**13**	**3Psg**	**6,520**	**20,400**	**18**	**3Pn**	**11,996**	**181,760**	**8**	**3Psg**	**11,904**	**49,930**	**13**
303	2,049	4,515	5	316	345	1,338	2	303	9,062	171,253	3	316	1,362	8,552	2
304	478	1,295	2	706	1,808	8,410	4	304	2,274	9,297	2	706	1,584	6,154	2
305	2,674	3,612	6	709*	156*	436*	2*	305	660	1,210	3	709†	not surveyed	not surveyed	-
3Psa	**9,354**	**21,504**	**10**	711*	1,054*	4,000*	3*	**3Psa**	**16,931**	**67,232**	**10**	711*	2,922*	13,451*	2*
298*	1,539*	5,428*	1*	712	2,533	4,599	6	298*	326*	2,072*	1*	712	2,510	6,844	6
299*	1,631*	5,111*	1*	716*	624*	1,618*	1*	299*	267*	582*	1*	716*	3,525*	14,930*	1*
300†	not surveyed	not surveyed	-	**3Psh**	**14,776**	**44,653**	**9**	300†	not surveyed	not surveyed	-	**3Psh**	**7,165**	**33,655**	**8**
306	1,405	3,109	2	318	1,425	5,058	3	306†	not surveyed	not surveyed	-	318	1,484	8,178	2
309†	not surveyed	not surveyed	-	707	2,032	7,125	2	309	10,917	45,810	2	707	3,063	13,456	3
714*	2,969*	4,118*	5*	708	11,163	32,034	2	714*	1,146*	2,001*	3*	708	2,618	12,021	3
715*	1,186*	2,120*	1*	709*	156*	436*	2*	715*	751*	1,839*	2*	709†	not surveyed	not surveyed	-
716*	624*	1,618*	1*	**4Vsb**	**8,255**	**16,520**	**7**	716*	3,525*	14,930*	1*	**4Vsb**	**8,990**	**34,457**	**3**
3Psb	**3,485**	**11,762**	**8**	397	3,939	5,800	4	**3Psb**	**1,254**	**4,413**	**6**	397	6,172	14,196	-
295	167	647	2	400	1,021	1,434	2	295	621	1,672	2	400	1,049	1,859	2
296	149	576	2	446*	3,295*	9,285*	1*	296	40	87	2	446*	1,768*	18,402*	1
298*	1,539*	5,428*	2*	**4Vsc**	**42,052**	**207,403**	**22**	298*	326*	2,072*	1*	**4Vsc**	**23,699**	**128,624**	**17**
299*	1,631*	5,111*	2*	398	4,594	17,046	7	299*	267*	582*	1*	398	5,741	18,937	6
3Psd	**9,908**	**16,693**	**23**	399	17,775	88,589	4	**3Psd**	**14,191**	**63,842**	**17**	399	3,348	18,018	4
313	230	679	3	446*	3,295*	9,285*	1*	313	1,685	17,967	2	446*	1,768*	18,402*	1*
705	883	2,378	2	451	1,267	2,705	2	705	4,116	22,348	2	451	4,969	40,877	2

Table 4a. Continued.

2011 (NW) Div./SA Stratum	2011 (NW) Biomass	2011 (NW) Abundance	2011 (NW) # sets	2011 (SE) Div./SA Stratum	2011 (SE) Biomass	2011 (SE) Abundance	2011 (SE) # sets	2014 (NW) Div./SA Stratum	2014 (NW) - Biomass	2014 (NW) Abundance	2014 (NW) # set s	2014 (SE) Div./SA Stratum	2014 (SE) Biomass	2014 (SE) Abundance	2014 (SE) # sets
713	4,017	5,781	7	452	8,171	65,821	3	713	2,968	4,758	7	452†	not surveyed	not surveyed	-
714*	2,969*	4,118*	9*	468	5,895	19,958	2	714*	1,146*	2,001*	3*	468	4,951	18,939	2
715*	1,186*	2,120*	1*	711*	1,054*	4,000*	3*	715*	751*	1,839*	2*	711*	2,922*	13,451*	2*
716*	624*	1,618*	1*	-	-	-	-	716*	3,525*	14,930*	1*	-	-	-	-
4Vn	**27,063**	**46,001**	**33**	-	-	-	-	**4Vn**	**22,526**	**84,732**	**26**	-	-	-	-
415	18,341	25,948	24	-	-	-	-	415	9,099	16,838	17	-	-	-	-
416	3,186	5,177	5	-	-	-	-	416	1,711	19,825	5	-	-	-	-
417	2,241	5,591	3	-	-	-	-	417	9,948	29,667	3	-	-	-	-
446*	3,295*	9,285*	1*	-	-	-	-	446*	1,768*	18,402*	1*	-	-	-	-
Sum	**55,012**	**105,383**	**87**	**Sum**	**71,602**	**288,976**	**55**	**Sum**	**66,899**	**401,979**	**68**	**Sum**	**51,758**	**246,666**	**40**
% in area	43.4%	26.7%	-	% in area	56.6%	73.3%	-	% in area	56.4%	62.0%	-	% in area	43.6%	38.0%	-
Both areas	**126,614**	**394,359**	**142**	**Both areas**	**126,614**	**394,359**	**142**	**Both areas**	**118,656**	**648,645**	**108**	**Both areas**	**118,656**	**648,645**	**108**

Table 4b-1. Summary of redfish abundance and biomass delineated by Southeast Management areas. Biomass is expressed in metric tonnes, abundance in number/1000.

-	2011 Biomass	2011 Abundance	2014 Biomass	2014 Abundance
3Psg	6,520	20,400	11,904	49,930
3Psh	14,776	44,653	7,165	33,655
4Vsb	8,255	16,520	8,990	34,457
4Vsc	42,052	207,403	23,699	128,624
All	**71,602**	**288,976**	**51,758**	**246,666**
3Psg	9%	7%	23%	20%
3Psh	21%	15%	14%	14%
4Vsb	12%	6%	17%	14%
4Vsc	59%	72%	46%	52%
% SE	**57%**	**73%**	**44%**	**38%**

Table 4b-2. Summary of redfish abundance and biomass delineated by Northwest Management areas. Biomass is expressed in metric tonnes, abundance in number/1000.

-	2011 Biomass	2011 Abundance	2014 Biomass	2014 Abundance
3Pn	5,202	9,422	11,996	181,760
3Psa	9,354	21,504	16,931	67,232
3Psb	3,485	11,762	1,254	4,413
3Psd	9,908	16,693	14,191	63,842
4Vn	27,063	46,001	22,526	84,732
All	**55,012**	**105,383**	**66,899**	**401,979**
3Pn	9%	9%	18%	45%
3Psa	17%	20%	25%	17%
3Psb	6%	11%	2%	1%
3Psd	18%	16%	21%	16%
4Vn	49%	44%	34%	21%
% NW	**43%**	**27%**	**56%**	**62%**
Both areas	**126,614**	**394,359**	**118,656**	**648,645**

APPENDIX II - FIGURES

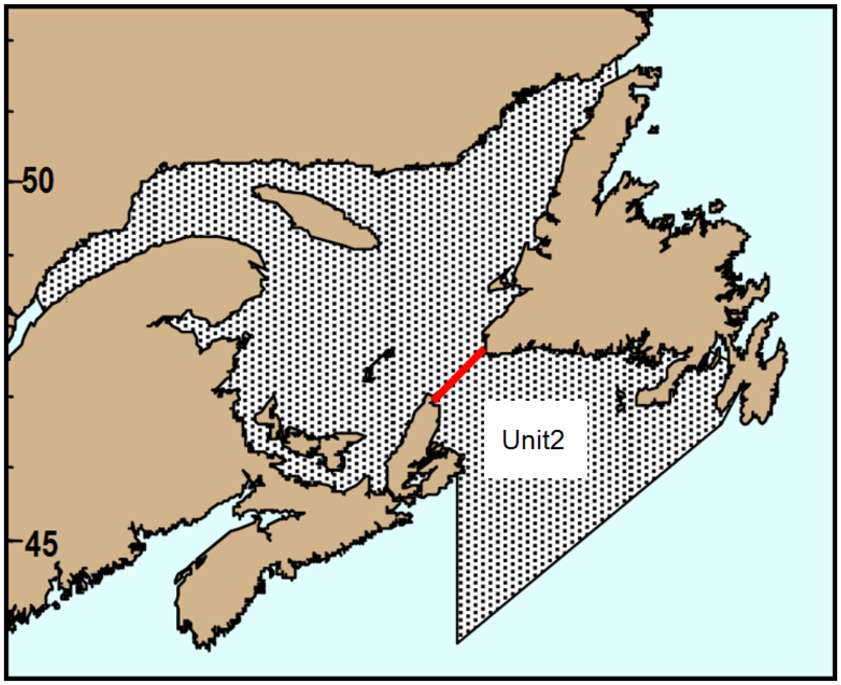

Figure 1a. Extent of Unit 1&2 Redfish stock areas. Unit 2 constitutes the areas outside of the Gulf of St. Lawrence, the lower portion of the area, below the red line.

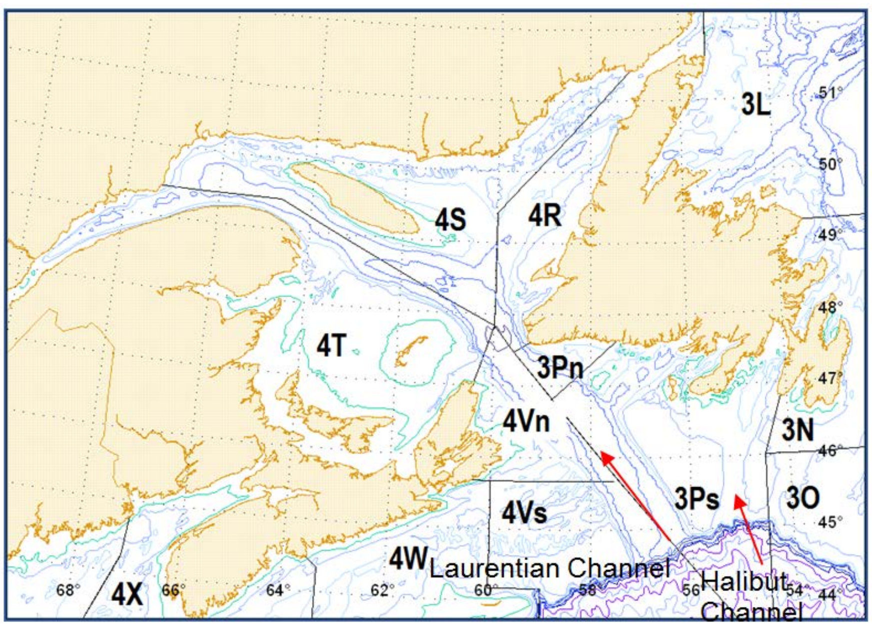

Figure 1b. NAFO Divisions and depth contours in the vicinity of Unit 1 and 2 stock areas. Unit 2 occurs in 3Pn, 3Ps, 4Vn, 4Vs and a small portion of southeastern 4W mainly in and around the Laurentian Channel (red arrow).

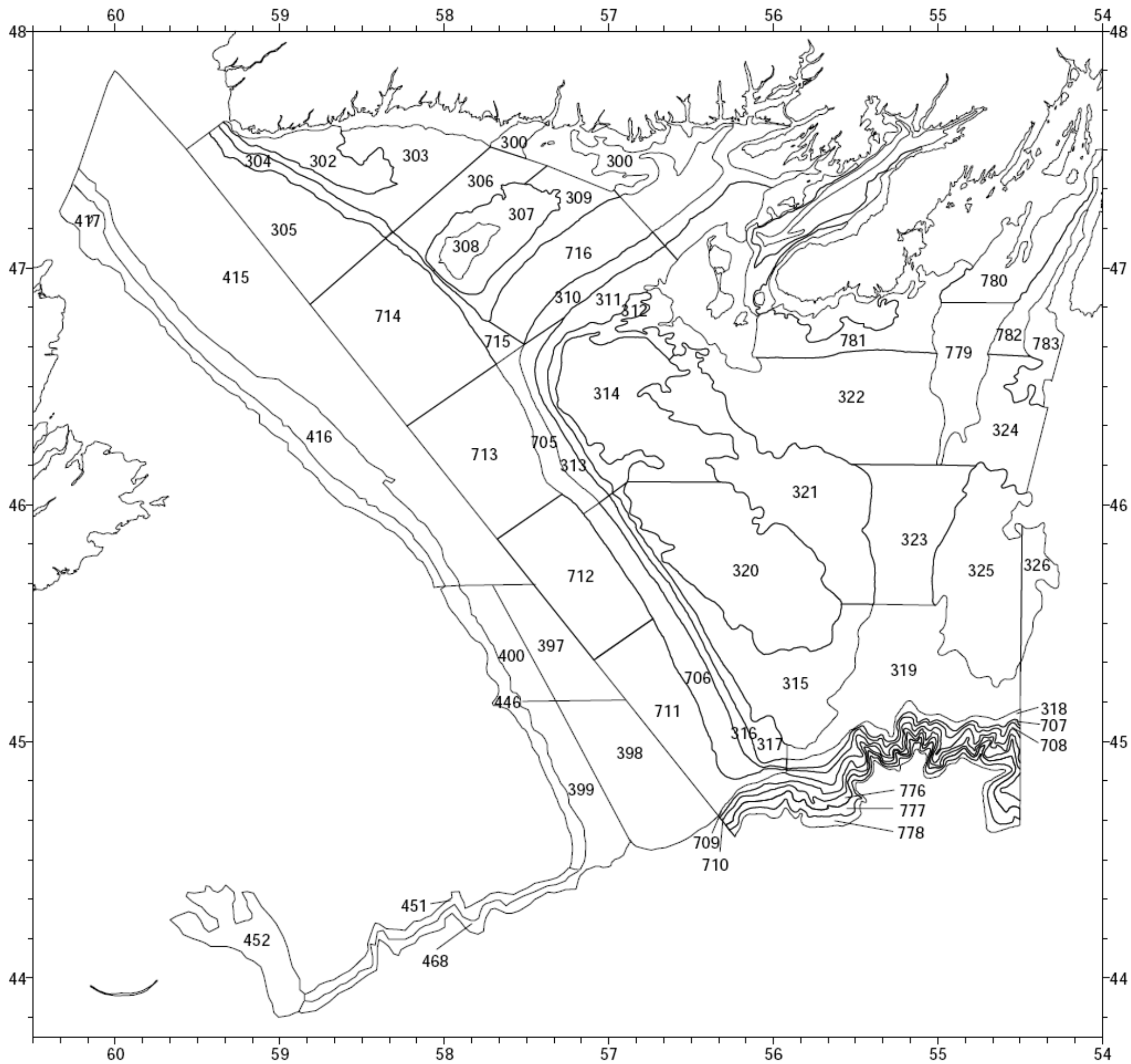

Figure 1c. Stratum boundaries within the Unit 2 stock area.

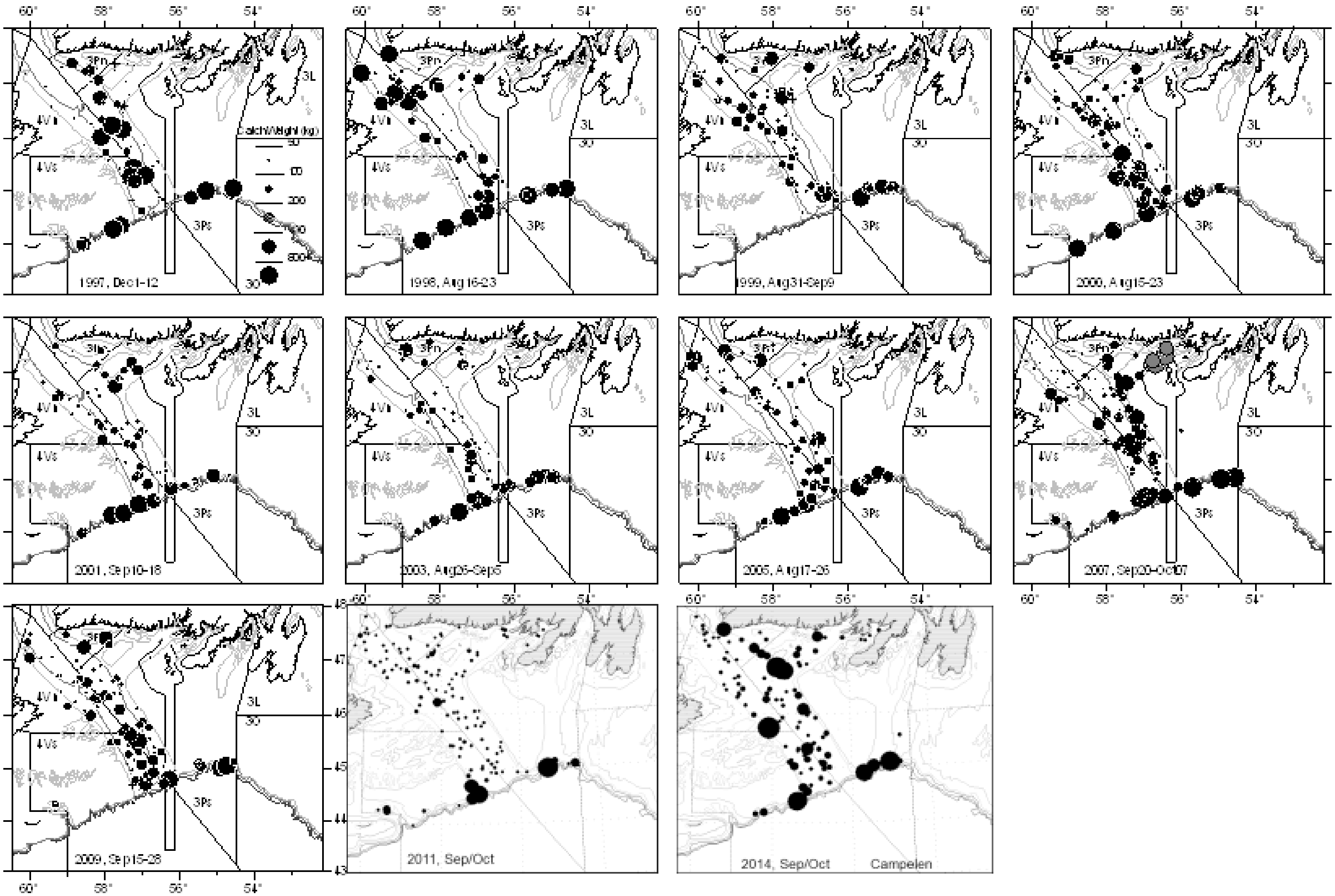

Figure 1d. Redfish catch weight distribution from GEAC stratified random surveys, Unit 2, 1997-2014 (200, 400, and 800 m depth contours are shown). A '+' indicates a tow with no redfish caught.

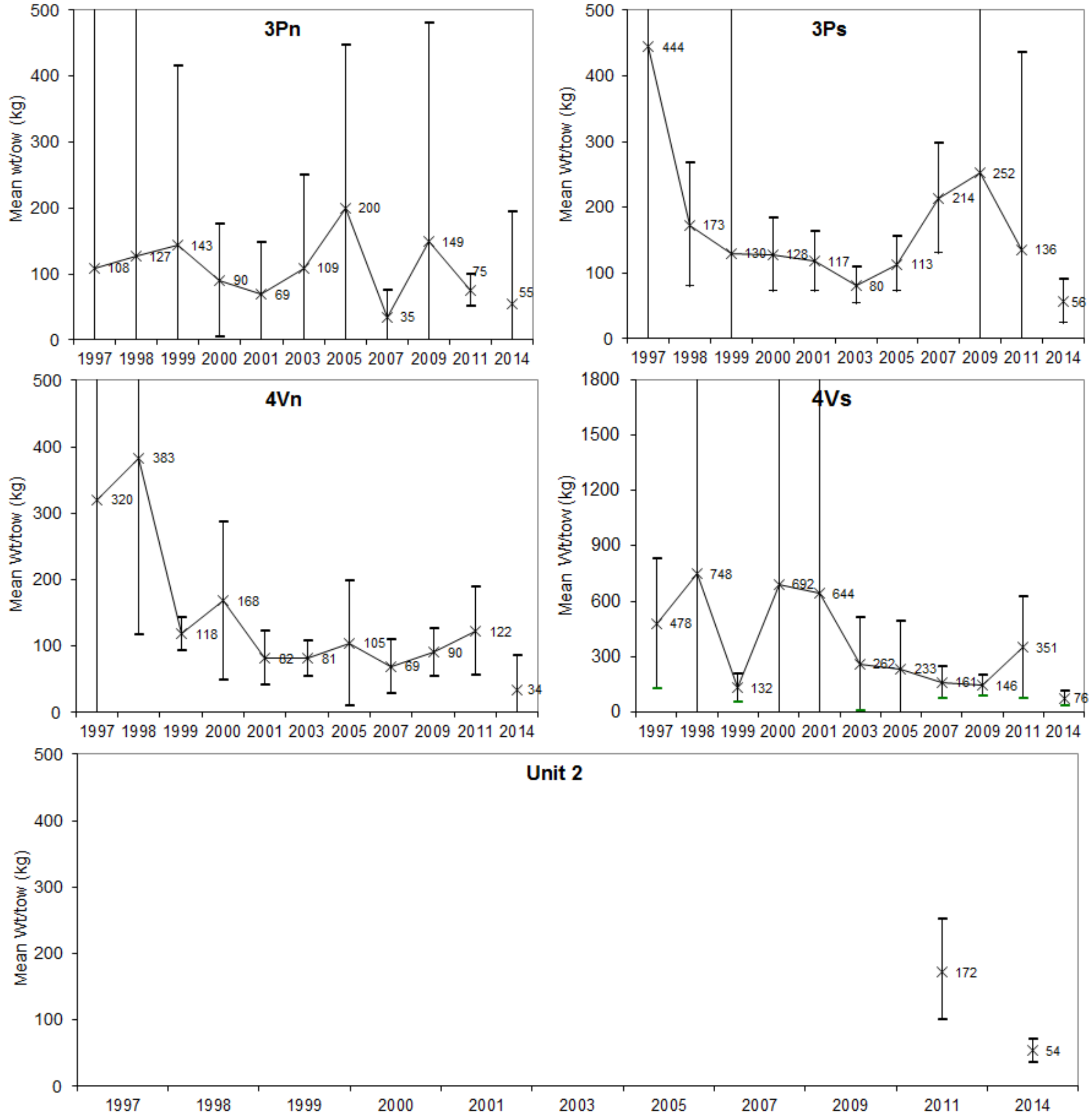

Figure 2. Mean weight (kg) of redfish caught per standard 30 minute tow for 1997-2011, 15 minute tow for 2014 from GEAC Unit 2 surveys. Ninety-five percent upper and lower confidence limits are also shown as vertical lines. The 2014 points are joined to the earlier years since survey gear changed in that year. Note the different (wider) scale for 4Vs. Unit 2 stock area data not available prior to 2011.

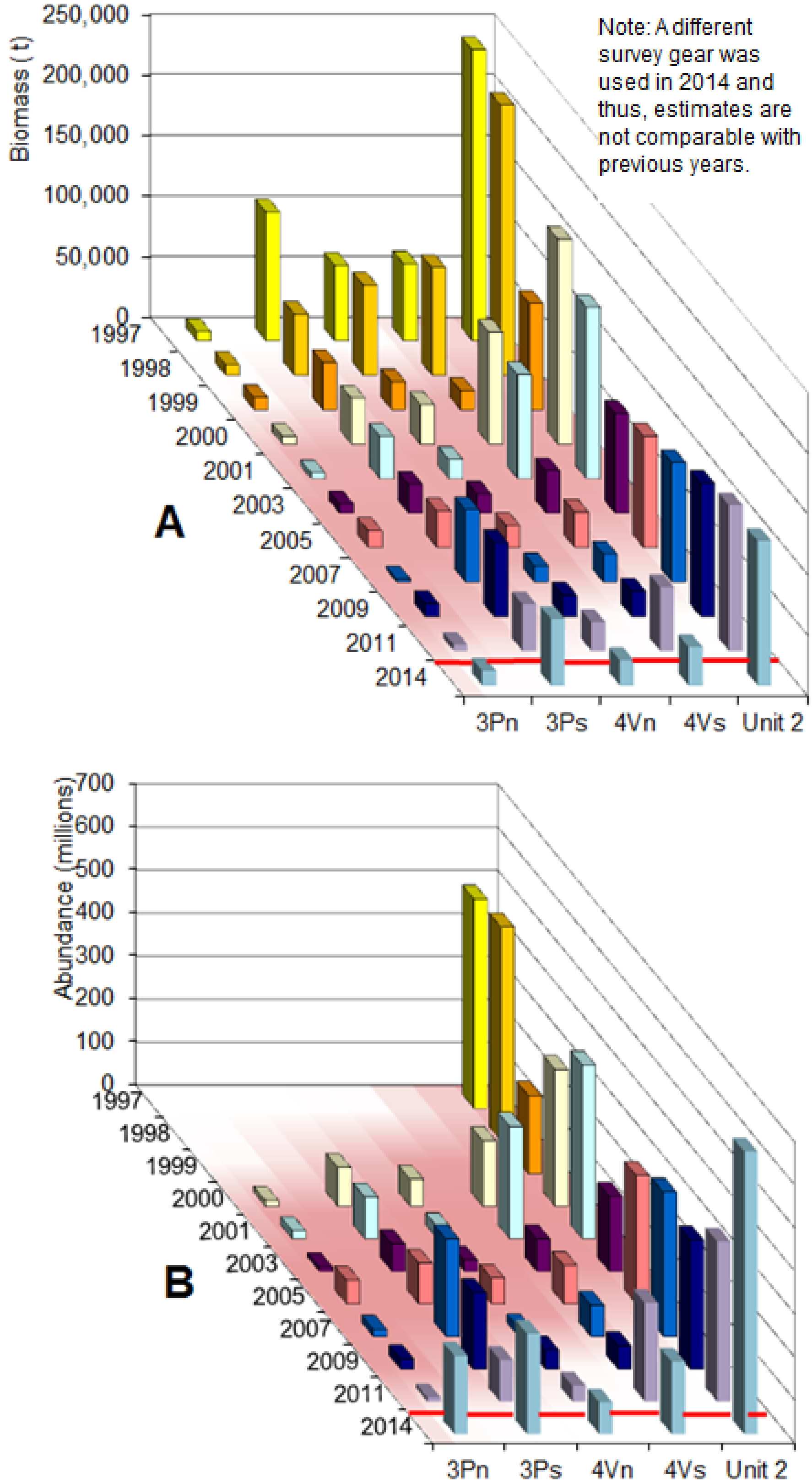

Figure 3. GEAC Unit 2 redfish survey catch estimates: 3a - relative biomass by year and Subdivision, 3b. - relative abundance by year and NAFO Subdivision.

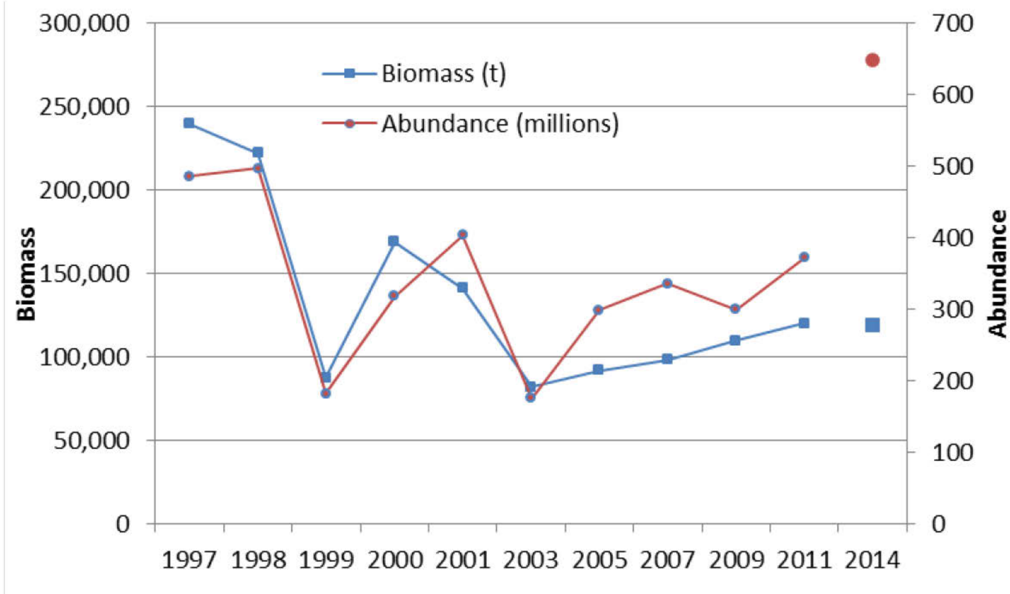

Figure 4. Biomass and abundance indices for the GEAC survey series. No line joins 2011 and 2014 data points because of the change in survey gear and thus, estimates in 2014 are not comparable to earlier years.

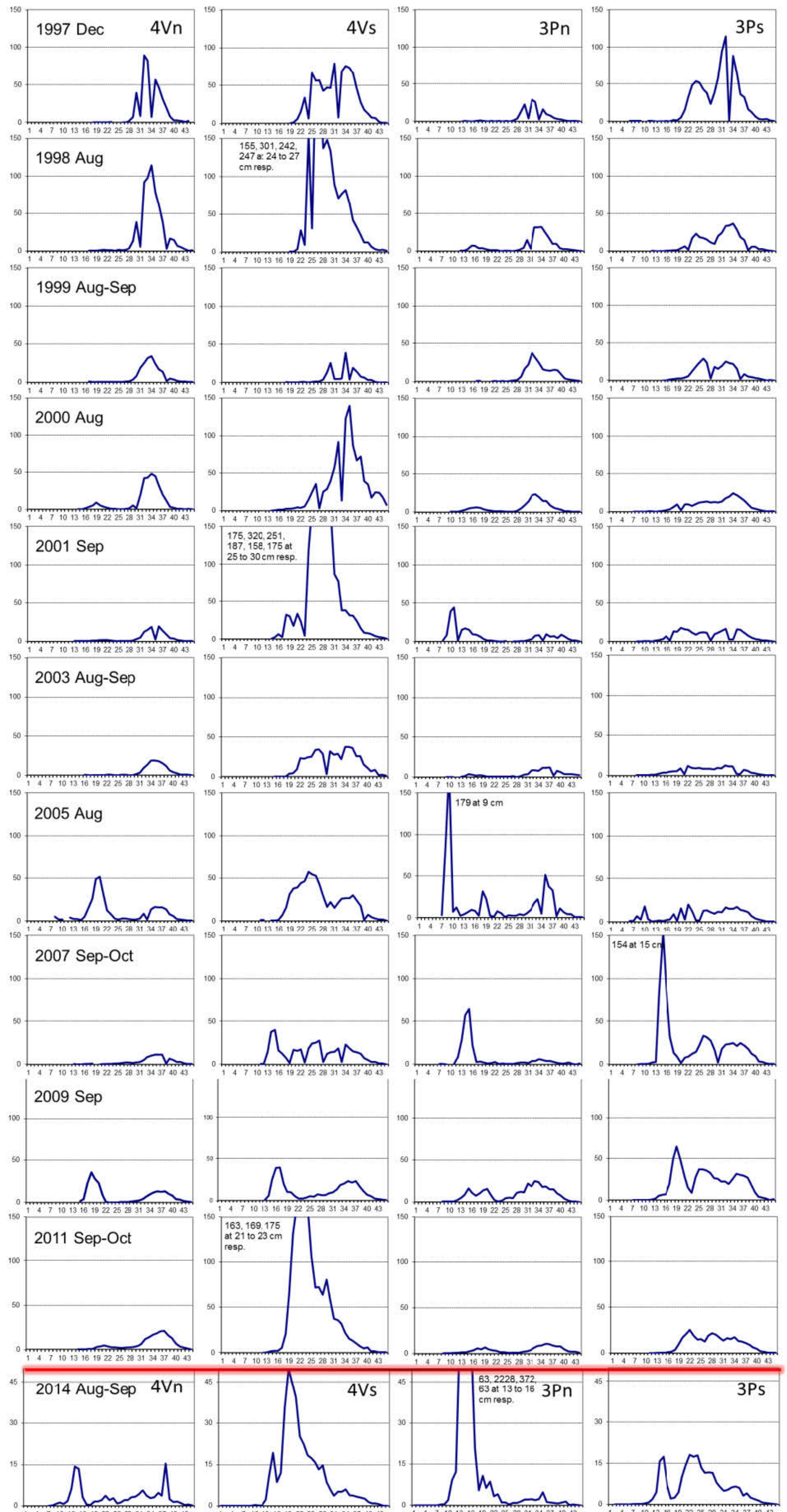

Figure 5. Redfish numbers at length by Subdiv. from GEAC Unit 2 surveys for 1997 to 2014. X-axis is from 1-45 cm and y-axis is mean numbers of fish/tow at length, scaled 0 to 150 up to 2011 and 0-50 for 2014. Below the red line, a different survey gear was used. In 1997-99, a liner was not placed in the trawl.

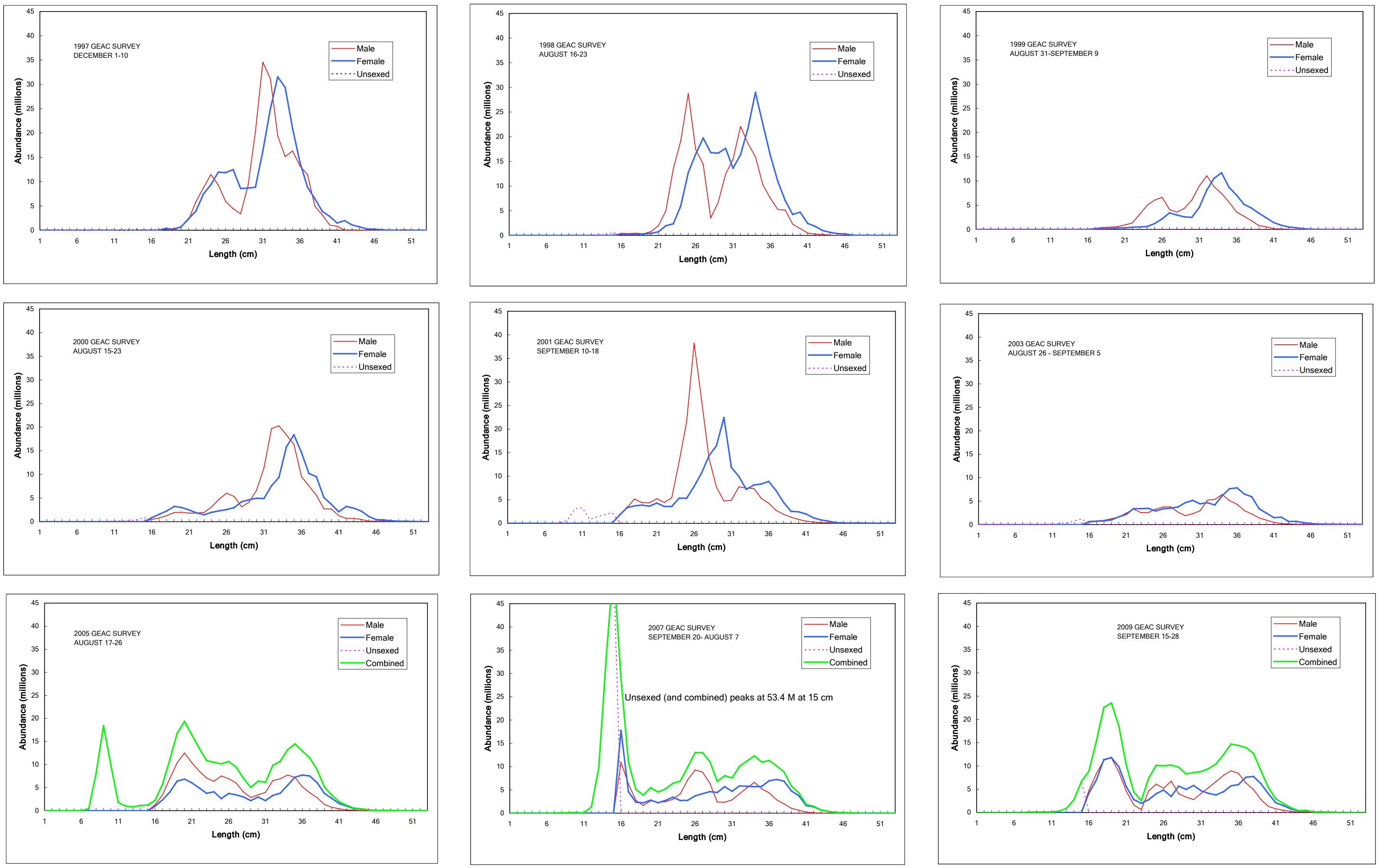

Figure 6a. Redfish survey abundance index at length from GEAC Unit 2 surveys from 1997 to 2009.

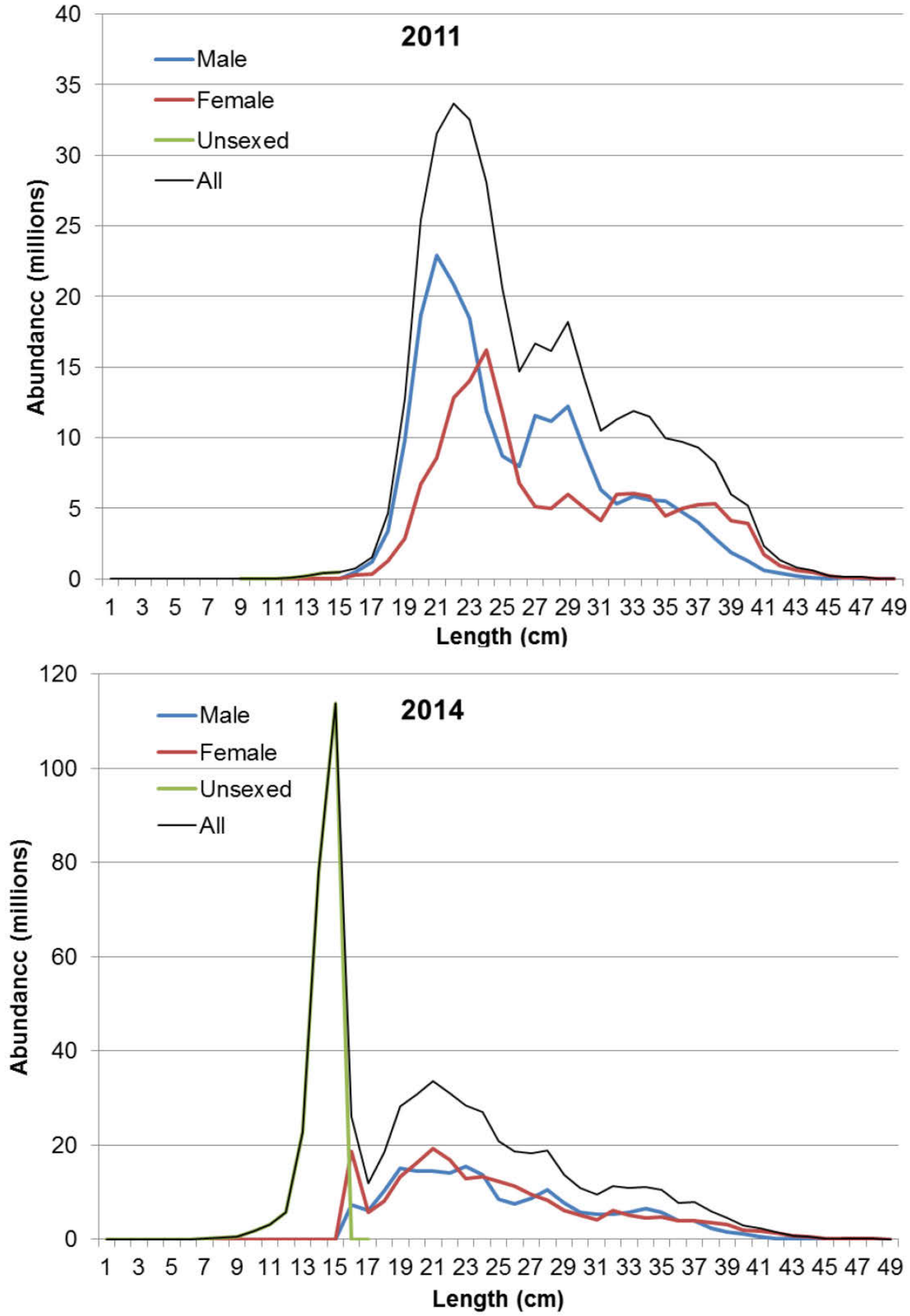

Figure 6b. Redfish survey abundance (numbers) index at length from GEAC Unit 2 surveys for 2011 and 2014.Note that 2011 and 2014 were sampled by different gears, Engel in 2011, Campelen in 2014.

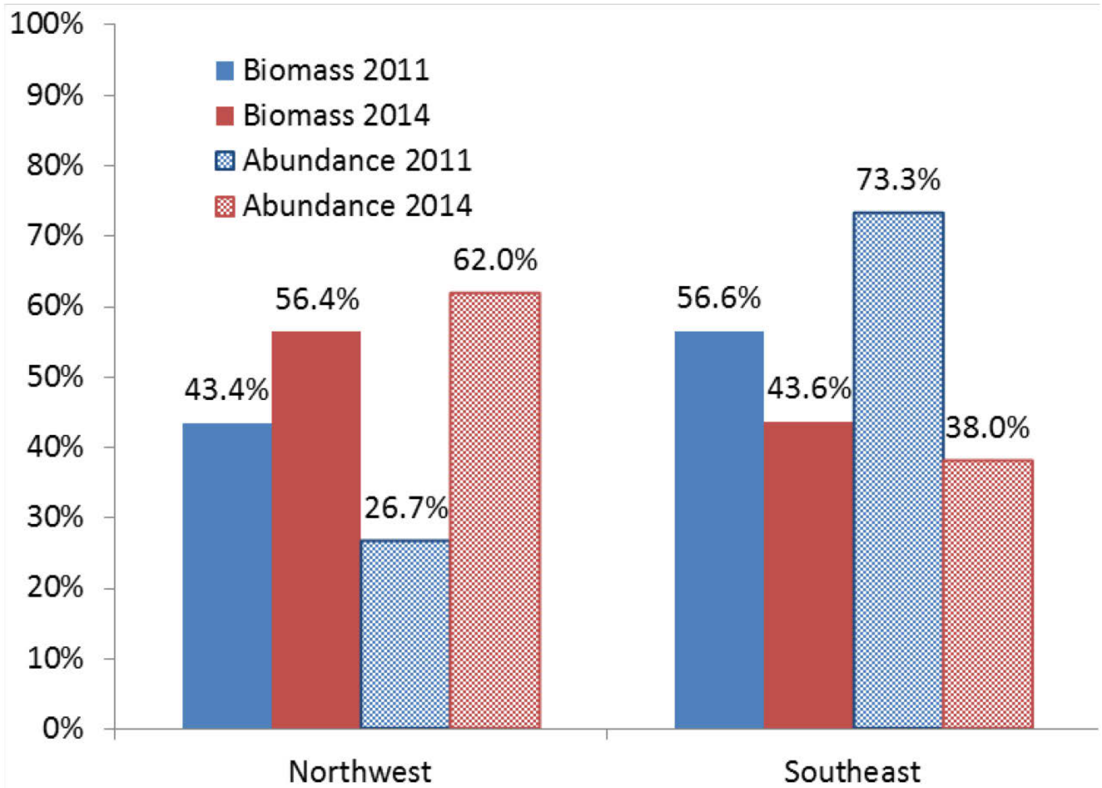

Figure 7. Proportion of abundance and biomass by management area (refer to Table 3).